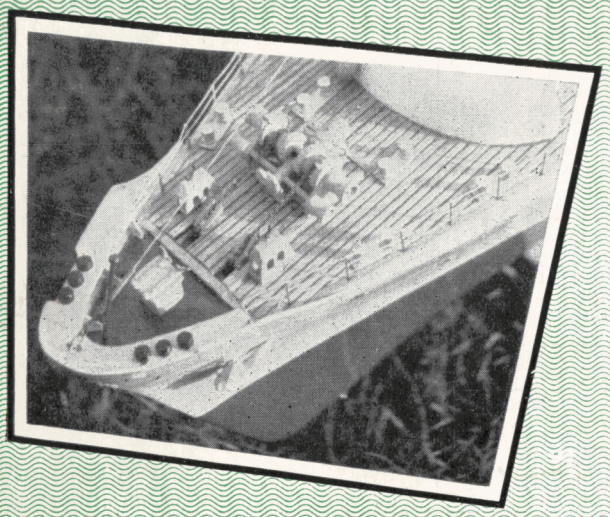
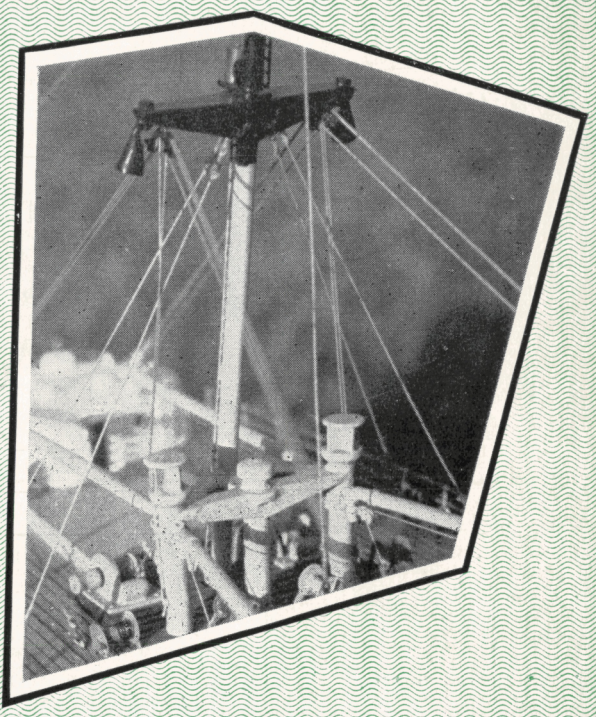
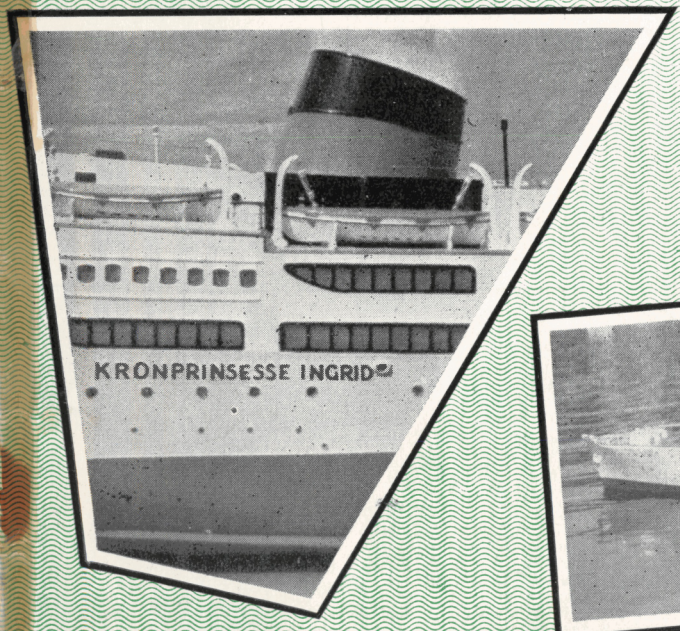
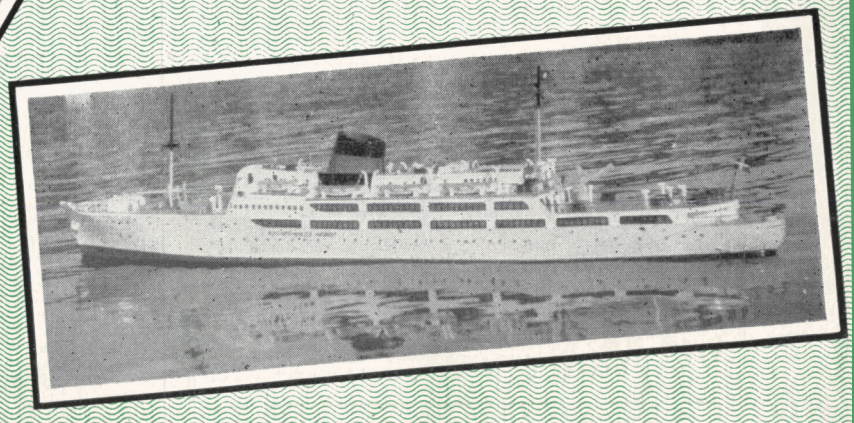
Model Engineer

THE MAGAZINE FOR THE MECHANICALLY MINDED









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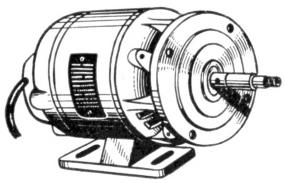

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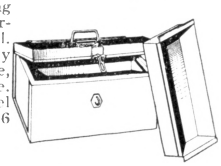

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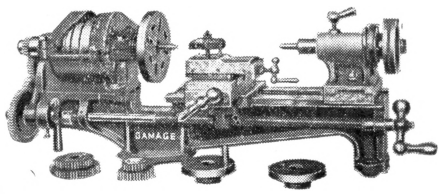

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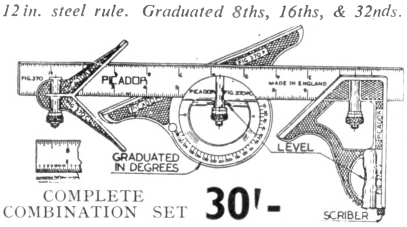

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All Prices plus Packing and Postage.

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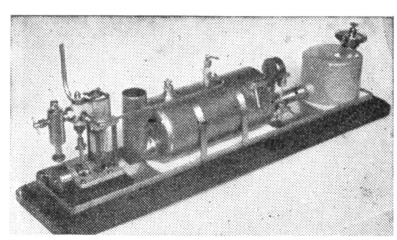

This plant is suitable for boats up to 48 in. long. The engine is ⅜ in. bore, ½ in. stroke and 4 in. overall height.

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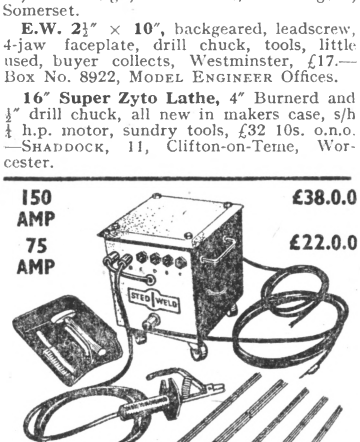

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MODELS AND FITTINGS

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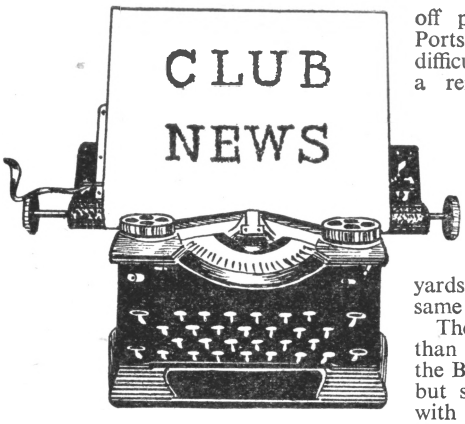


EDITED BY THE CLUBMAN

THREE days before the City of Bath Mini-Car Club inaugurated a new long distance race for rail cars the Lord's Day Observance Society issued a warning that the club's intention to charge for programmes was illegal. As a result the club could not cover its costs and is now at least £10 in the red.

Despite this loss, the Bath Grand Prix was worth the cost. The club will develop the event and introduce a suitable trophy for the winner.

Each club was allowed to enter a team of cars for the 500 laps—representing an actual distance of 14½ miles. The cars had to be within the MRCA formulas One to Four, but no libre entries or specials were permitted. A pit-stop atmosphere was simulated by requiring the teams to change their cars every 50 laps.

Bournemouth did very well by spreading its team at the vital pick-off points. On one occasion the Portsmouth team apparently fell into difficulties somewhere, for there was a remarkable sequence of goods-yards tactics with two cars on the same track.

The race was only 13 sec. shorter than the ¾ hr estimated. At one time the Bath club was full 15 laps behind, but some extra tuning by G. Todd with his Cooper 1,000 saved the day. With the end in sight, this car (ED 146 powered) was lapping the track at 3.4 sec. consistently—and the track was 166 ft long.

There were some near misses for the public, notably when Richard Rasbach's ED 146 racer left the track and careered across the hall.

The Bath club was first with 44 min. 47 sec. **Portsmouth MCC** tied with **Bournemouth and District** for second place.

VETERAN PRESIDENT RETIRES

When F. Cook retired as president of the **City of Leeds SMEE** the society presented him with a 3 in. three-jaw Burnerd self-centring chuck, suitably inscribed. The presentation was made by H. Donald, his successor who is seen on the right of the picture.

At the same time Mr Cook, who is a founder member, was made an honorary member for life. He had held the presidency for most of his 23 years with the society.

ME DIARY

June 14 National Traction Engine Club, Appleford Rally, near Didcot, Berks.
Railway Enthusiasts Club in Derbyshire and Cornwall; camping coach holidays.
Birmingham SME annual summer outing to Windsor by special train.
June 15 Malden and District SME club invitation day.
Coventry MPBA regatta, Nauls Mills Park, 11.30 a.m.
Mortlake MPBA regatta (radio-control), Barnes Pond, 11.30 a.m.
Harrow and Wembley SME track day, Headstone Lane (afternoon).
June 18 Bristol SMEE "Modern Production Methods in the Engineering Industry," R Philips, Folk House, 7.30 p.m.
June 20 Birmingham Ship Model Society, "Mass Production Methods in Modelling," F. A. A. Pariser, Imperial Hotel, Temple Street, 7.30 p.m.
Rochdale SMEE members' work, Lea Hall, 7.30 p.m.
Greenwich and District SMS "Nineteenth Century Rigging," A Cassell.
June 21 Birmingham SME track running, Wilmot Breedon's Sports Ground, Coventry Road, Elmdon.
The Society of Model and Experimental Engineers Diamond Jubilee Exhibition, 28 Wanless Road, London; opened by Earl of Northesk, 3 p.m. June 21-28 (not Sunday), 2 p.m.-9 p.m.
Bristol SMEE track day at Canford Park.
Ickenham and District SME annual open day and exhibition at headquarters behind Coaches and Horses, Ickenham.
June 22 Victoria MPBA regatta.
June 24 Sutton Coldfield and North Birmingham MES, "Vanishing Crafts of the Countryside," S. A. Howard.
June 26 The National Threshers Reunion, Williams County Fair Grounds, Montpelier, Ohio (Alt. US 20, South; four miles Bryan-Montpelier Interchange on Ohio Turnpike). June 26-28.
July 6 Thames Shiplovers' annual rally of sailing ships and models.

READY TO GO

With a membership of more than 70, **Sutton Coldfield and North Birmingham MES** has little cause for worry. At the recent annual meeting the officers were re-elected together.

The society now has its own epidiascope and 16 mm. sound projector. Work is nearly finished on the portable track, and the 5 in. gauge club locomotive, which has already been under steam on the permanent track, is ready to go.

SUMMER WILL BE BUSY

Live steamers of **Hitchin and District MEC** had a chance to put their locomotives through their paces at the recent open day, the beginning of a full summer programme

Work progresses slowly on the smaller gauges. The society now meets on Wednesday evenings to speed up track laying and rebuilding.

Earlier events this year included the club dinner and a visit to Stratford locomotive works. Anyone interested in Hitchin's activities should write to secretary G. Clarke, 35 Station Road, Lower Stondon, Henlow, Beds.

A ship modeller's diary

FOUR classes of models are open to all when the Thames Shiplovers hold their ship model rally at the Round Pond, Kensington, on July 6.

The main event is for Thames sailing barges. In this the conditions are stricter than for the other classes. The models must be to a scale of ½ in. to 1 ft and be faithful to prototype in profile and deck detail. Like the other classes, they are judged " on the grass " and must demonstrate their capacity to float and sail.

They are finally judged on the results of a race between themselves. The grass tests determine their eligibility for entry to the race, and failure to measure up to the conditions still permits entry into the fore-and-aft rig class. The square-rigged class usually produces the rally trophy winner, for here may be found the tops'l schooner, the five-masted ship, and all that lies between them.

As for the experimental and native craft, these are closer together than you may think. The new-fangled catamaran of the modern British yachtsman, with its fantastic turn of speed, is probably several thousand years away from the Indonesian catamaran—but at the rally they may race, in model form, side by side.

Have you anything that sails ? Why not write for an entry form to the secretary, Mr J. Fisher, 106 Chester Drive, North Harrow, Middlesex ? A few stewards are also wanted; and in any event it is a day out for you and the family in pleasant surroundings, with light refreshments on hand.

Summer programmes

MENTION of the rally reminds me that many ship model societies have summer programmes which include one outing at least. The Thames Shiplovers are going to Southampton, London Docks and a shipbuilding yard. These are organised and conducted tours, usually with a visit to a ship. If you prefer to visit London drop a line to Mr Fisher for particulars.

There is also a Thames-side Strollers group, quite informal and conducted by Mrs K. Beer of 107 Lampton Road, Hounslow, Middlesex. As the name implies, strolls are taken along the sides of the Thames.

What do you know of Traitor's Gate, The Prospect of Whitby, or Cherry Gardens Pier ? You'd be surprised at what a stroll can produce in history, knowledge and new friends.

New England catalogue

RECENTLY there came into my hands from a friend in New York a catalogue of Ship Models in the Museum of Fine Arts at Boston. It is well illustrated and shows many of the ship models on view, some up to the full size of the page, 11 in. × 8½ in.

What caught my eye, as an old sailor, was the " shin cracker " steering gear of the schooner *Wave*. It is so unusual that it is worth describing at some length.

The schooner itself is a wooden vessel with a squarish overhanging counter. The whole of the steering gear is mounted on the tiller. This includes two ornamental posts for mounting the 4 ft wheel, to which is attached a 1 ft dia. dolly or drum. The drum has a dozen turns of 2 in. rope steering tackle, the ends of which are led through two cheek blocks, one on either side of the tiller, to two simple tackles attached to the tiller end. The tackles extend about 5 ft out and are attached to the deck on either side. The ends of the rope steering tackle are made fast to the heel of the blocks on the tiller end.

I feel sure that many a helmsman had his shins cracked when steering in a lively sea as he manipulated the wheel with his weather eye aloft and his lee eye on the movements of the tiller.

The date assigned to the *Wave* is *circa* 1860 and she appears to be registered in North River, New York. The very big jib foresail is fitted with a boom, the for'ard end of which is short of the tack by 4 ft but is free to operate on a runner out to the tack of the jib foresail.

Dockyard models

Nearly half the models are of early English ships, including such vessels as the *Prynce Royall*, 1610, *Sovereign of the Seas*, 1637, *Royal George*, 1715, and at least one by French prisoners of war, the *Heros* 1781, a very fine piece of craftsmanship in whalebone and baleen.

Two of the fine works in this New England Museum are English dockyard models, *The Royal George*, 1715 and the *Prynce Royall*, 1610. *The Royal George* for example is covered in the catalogue by no fewer than 11 beautiful photographs and though she was built over a century later than the *Prynce Royall* she claims our attention because of her carving and general decorative work.

Both these vessels came from a leisurely age and they were made for demonstration purposes only; to be shown by the designer to the people who had to fight and to those who had to pay for the cost. Long before the model itself was completed the shipwrights and the riggers composed their differences. The armourers had a go. The sailors wanted to know: " Would there be room for the sailors, the stores and the ammunition ? When she was built, would she float ? " What hectic times they were ! " Was she fast ? Why not more chaser guns ? How can guns be fired through rigging ? " So it went on. Small wonder such models are a headache to research workers of a later age.

Both these models had the lateen spar and both also had the sprit topmast. How then did they differ ? The *Prynce Royall* had the long beak and the high stern and she had only 56 guns, but she was England's first three-decker. The *Royal George*, a three-decker, was more compact looking and had 100 guns.

These two models rest in the birthplace of the *Flying Cloud* built three centuries later.

Model Engineer Exhibition

A REMINDER to secretaries: have all your members got entry forms for their models ? Please make sure that the society's name appears on the entry form. On this depends the Club Team Cup and the Maltby Trophy awards which are highly sought after by societies. The organisers this year have allotted space for the stand of the Ship Model Societies under the leadership of Mr William Guy. Please let him know if and when you are available for stewarding duties at the stand. Even if you are a lone wolf you are welcome, so drop him a line at 351 Kingshill Avenue, Hayes, Middlesex.

Show at Gravesend

There was much to interest the Mayor of Gravesend when he visited the exhibition of The Thames Group Marine Modelling Society. H. G. Cox won the premier award with his working model of a radio-controlled ocean-going tug. ▣

piece of $1\frac{1}{2}$ in. r.m.s. and $\frac{5}{16}$ in. r.m.s. supplied the piston rod.

The rear cylinder head was made from $\frac{1}{4}$ in. m.s. plate, and the front cylinder head was turned up from 2 in. r.m.s. The cylinder supports (which are also housings for the wobble shaft) were made from $\frac{3}{8}$ in. 2 in. m.s. bar. The cylinder locating straps were made from $\frac{1}{8}$ in. $\times$ $\frac{3}{8}$ in. m.s. and the cylinder was located with 3 in. $\times$ $\frac{3}{16}$ in. Whitworth studs at each 120 deg. apart.

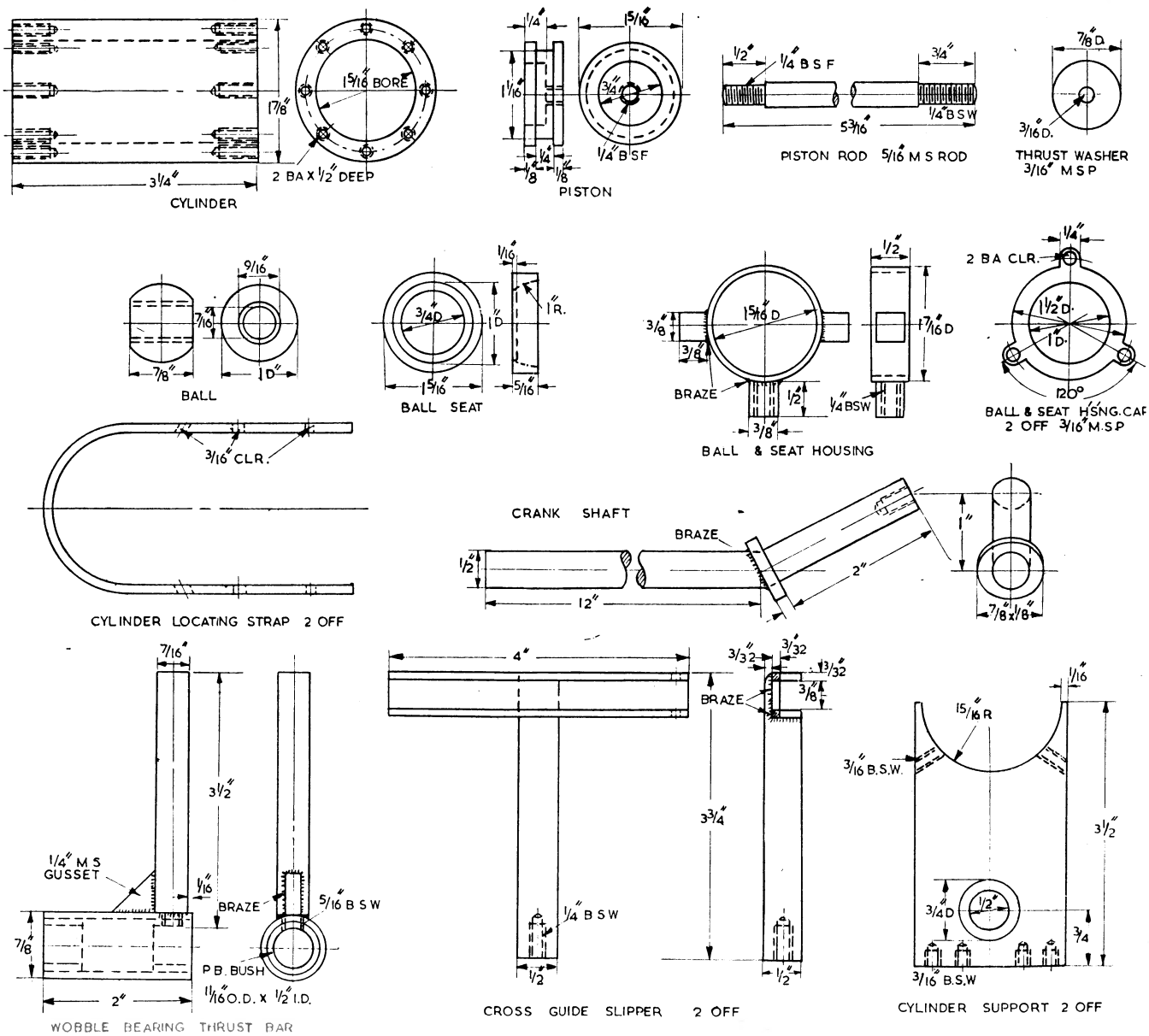
Normal eccentric and valve mechanism was used, but the valve chest was located to the bed, and distributor pipes were used from the ports to the cylinder. The chest was fabricated from $\frac{1}{4}$ in. m.s. plate, and the chest back with suitable steam ports and passages was made from a piece of $\frac{3}{4}$ in. $\times$ 2 in. $\times$ 3 in. steel, cut out of the top section of railway line.

The bed was made from a piece of $\frac{1}{4}$ in. m.s. plate 5 in. $\times$ 10 in. suitably cut away for the crank and drilled.

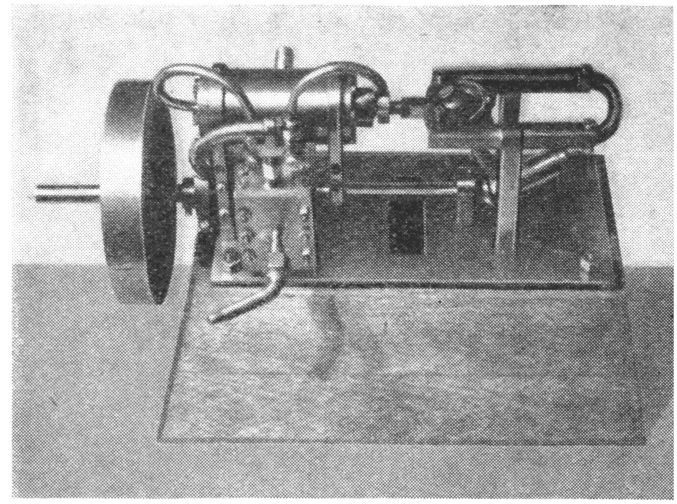
The completed engine was mounted on a hardwood base. On a compressed air test at approximately 50 p.s.i. it turned over at 500 r.p.m.

The result is I think a true prototype and a simple model to build

The main point to watch is the correct alignment of the thrust bar, which should be mounted at the centre of the shaft bend to function correctly. ▣



A wobble-crank steam engine



Fabricating a stationary engine with an unusual drive shaft

By J. WILSON

FOLLOWING the advice of Mr Michael Oxley, the engineer humorist, I decided to build a steam engine (without plans, and making each piece and adding it to the next) with an unusual form of drive shaft. My shaft was to wobble and not to crank. I have always found great difficulty in building up a crankshaft accurately, but there would be little difficulty in bending one.

A 14 in. length of $\frac{1}{4}$ in r.m.s. was produced and a saw cut made 2 in. from one end, and the shaft end bent up 1 in. A $\frac{7}{8}$ in. $\times$ $\frac{1}{8}$ in. washer was brazed on the shaft at the bend forming a thrust pad. The wobble end was drilled and tapped $\frac{3}{16}$ in. BSW to locate the wobble bearing and the forward thrust pad.

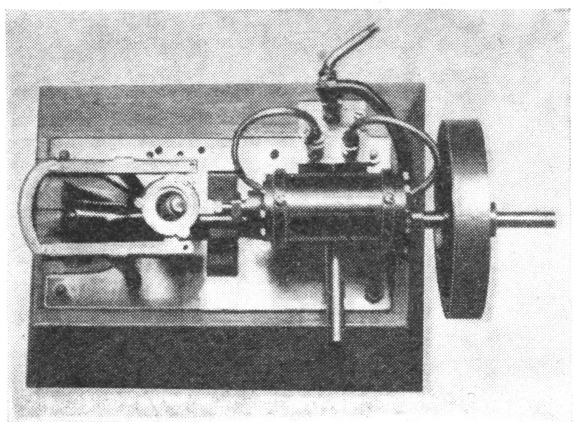
The wobble crank bearing housing and the thrust bar was made from a 2 in. length of $\frac{7}{8}$ in. r.m.s. This was drilled out $\frac{5}{8}$ in. dia. and a $\frac{1}{2}$ in. i.d. phosphor bronze bush $\frac{1}{2}$ in. long was inserted at either end.

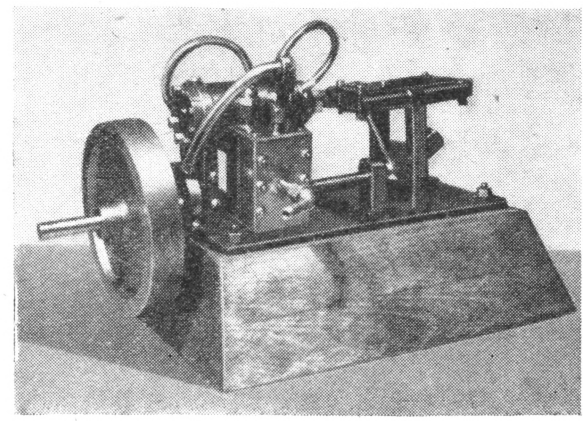
The end was drilled and tapped $\frac{5}{16}$ in. BSW to take a $3\frac{1}{2}$ in. length of $\frac{7}{16}$ in. r.m.s. suitably reduced and threaded at one end. The thrust bar was then gussetted and brazed to the bearing housing. Gussetting and brazing was found necessary after the first test when the thrust bar was torn out of the bearing housing.

The crosshead, operating the thrust bar, was made from the steering knuckle of a car. The knuckle pin was sawn off the ball, a $\frac{9}{16}$ in. hole drilled through the crown and a $\frac{7}{16}$ in. bush inserted. The bushed ball and the two semispherical seats were fitted into a cage made from a $\frac{1}{2}$ in. length of $1\frac{1}{2}$ in. $\times$ $\frac{3}{16}$ in. gauge water-pipe. Caps were made from $\frac{3}{16}$ in. m.s. plate, and three lugs $\frac{3}{8}$ in. square were brazed on to the pipe to form guide lugs and piston rod connection. Caps were held in position with three No 2 BA nuts and bolts.

The crosshead guides were fabricated from $\frac{1}{8}$ in. $\times$ $\frac{3}{8}$ in. m.s. 4 in. long, supported on $\frac{1}{2}$ in. square columns which were bolted to the bed. The cylinder was turned up from a $3\frac{1}{4}$ in. length of 2 in. r.m.s. and of a bore $1\frac{5}{16}$ in. each end, was drilled and tapped 2 BA for cylinder head bolts (eight each end).

The piston was turned up from a





wheel oscillating cylinder locomotive with a cast brass frame, and incidentally, castings of this type were advertised by Bateman's as long ago as 1888.

After fitting a new boiler and cylinders I found it did afford a good deal of interest to a modern young man of 12. I am of the opinion that this Beyer-Garratt would have a great appeal for budding model engineers—and why should they not have a little encouragement sometimes ?—so while confined to bed, following a heart seizure, I consoled myself by ordering the requisite materials to make one for a small boy and hope it will not be long before I can make a start.

Now as regards this Greenly undertype engine in the Science Museum, is it an accurate model ? I have a fair number of contemporary illustrations of these engines, but in no case have I come across one with a Belpaire firebox, nor have I ever heard of a Belpaire firebox on an agricultural or traction engine. I suggest too, that the locomotive type regulator is wrong. In these engines the steam pipe came through the smokebox and was fitted with a wheel stop valve; alternatively there was a sliding valve on the steam chest operated by a long lever under the smokebox door. I suggest that Mr Greenly designed the boiler in this way to make it easy to construct for the boilersmiths of 1903, who might not be up to making a round-topped boiler.

Woking, Surrey. H. E. RENDALL.

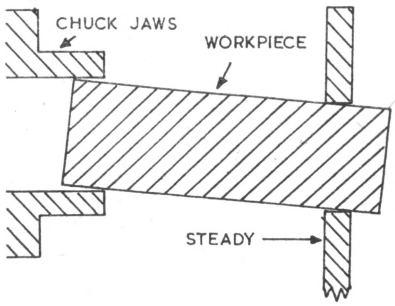
WHY FOUR POINTS ?

SIR,—With all due respect to Mr G. C. Moore on his four point steady design [ME 118/491, April 17], I cannot see any great advantage over a three point steady on a small lathe.

In fact, I think in any case three points only will be in use most of the time. From my experience where a steady is occasionally required, very heavy cutting is not undertaken and one steady point at the top is sufficient.

Regarding his last paragraph about the job working out of the chuck, I would suggest this is due to a see-saw action caused when the job is not set up correctly, as shown much exaggerated in the sketch. Where one end of the job is held in the three-jaw chuck, it is essential a true seating is turned on the job for the steady points. These should be very carefully adjusted up to the work and only just touch; they must not make a hard bearing. If the points bear hard on the job, unnecessary wear occurs and heat is generated, necessitating more lubrication.

If the job is already in a finished condition but a steady must be used on it for a further operation, it should be set up dead true in a four-jaw chuck and the steady rest jaws carefully adjusted to the job, with some brass or leather packing between the jaws and the job if the latter must not be marked.



An exaggerated view of what happens when work is incorrectly set in the chuck. See the letter from Mr J. H. Davis

Wembley, Middx. J. H. DAVIS.

HYDRAULIC TRANSMISSION

SIR,—I feel that Mr Bellemy's letter [Postbag, April 3] cannot go unchallenged, in view of the very sweeping statements he has made.

Reading between the lines I can only assume that Mr Bellemy is a steam " fan " who adopts the ostrich approach to rail traction when the word diesel is mentioned.

The special train which *Active* hauled on February 17 had a tare weight of 328 tons as compared with the average Bristolian's 245 tons—a point that Mr Bellemy has ignored or failed to mention. A King might have made a showing with such a load on the drawbar, but certainly not a Castle.

Again *Active's* run to Bristol was made with the introduction of a number of stops, the reason for which is best known to the powers that be and Western Region in particular. The fact was that she could not make much of a showing on such a schedule but, even so, she topped Dauntsey bank at 80 with little effort, in spite of her 300 ton-plus load. The trouble on the up run was a piece of sheer bad luck and, if Mr Bellemy was aware of its true nature, he must understand the futility of his statement: " No wonder the contraption fell to bits on the return journey."

The fault concerned one engine only, and was so slight as to be of minor importance. On her extended trials in Scotland *Active* (or No 600, as she then was) gave a very good account of herself and to dub her with the soubriquet of " contraption " is to belittle the work of those responsible for her design and construction—men who, I would venture to say, know rather more than Mr Bellemy about locomotive design, whether it be steam or diesel.

The fact that her top speed is limited to 90 m.p.h. is nothing to go by, as this was the designed speed. It is certainly not the maximum or the practical limit of a locomotive of the same powering and I would suggest that one has to look further than Great Britain to put the diesel locomotive in its true perspective. Does Mr Bellemy know of the V200 of the German Federal Railways, turning out a regular 100 m.p.h. with engines of the same power output as *Active*; has he forgotten the Flying Hamburger of 1936; does he completely overlook the performance of the diesel locomotive on the metals of the USA; does he brush aside the English Electric *Deltic*, and the scores of other diesels already operating on British Railways ?

We cannot put back the clock and the day is not far distant when the diesel locomotive will equal and better the best of steam. When that day is reached the main line diesel will have approached its zenith and it, too, will give way to the all-electric locomotive—the ultimate as far as we can see today.

Baillieston, near Glasgow. J. H. COURT.

CUTTY SARK . . .

Continued from page 759

The masthead, which is $\frac{11}{16}$ in. long for the mizen and $\frac{15}{16}$ in. for the fore and main masts, should be reduced in diameter as shown in Fig. 38 with flats on each side. Cheeks made from Bristol board should be glued to each side of the mast, and trestle trees 1/32 in. square should be glued along their upper edges. They could be made of bamboo as it can be split easily to this section.

The mast tops should then be cut out of plastic sheet about 1/32 in. thick with holes for the masts and the shrouds as shown. The larger of the round holes should be a good fit on its respective masthead. The top should then be glued and pushed down on to the trestle trees which are flush with the shoulder on the mast, care being taken to have it square with the trestle trees.

● *To be continued*

First, the sandblast material erodes away the metal points and, worse, removes the polish from the porcelain insulator, thus encouraging the reformation of carbon deposits and substantially reducing its insulating qualities.

Secondly, if the plug is really fouled and moist with oil, the sandblast material beds into this goo and no further cleaning occurs up in the joints.

My method which I have used for 30 years—ever since I have owned a car, is to remove the copper washer and nut from the plug and immerse it in a boiling solution of sodium hydroxide (caustic soda) approximately equal parts by weight. This liquid is highly caustic and should be kept in a small steel tank free from soldered joints. It would be found that after 30 min. of this treatment all the oil binding the carbon has emulsified, leaving the deposit a soft spongy mass which can easily be washed off with a high-pressure jet of water, properly directed, and assisted if necessary by a thin sliver of wood.

It will be found that when plugs are so treated, they are equal in every respect to new, and the operation can be repeated indefinitely. However, I have only treated plugs with porcelain insulators and therefore cannot express an opinion as to the effect this treatment would have on some of the built up mica plugs used on high compression engines.

Kingston, Jamaica. HARRY E. VENDRYES.

PRAISE FOR GEOMETER

SIR,—I feel moved to drop you a line to say how much I have appreciated Geometer's "Workshop Hints and Tips" since this feature commenced. To my way of thinking it is the best series of the kind I have ever come across and it is to be hoped Geometer will keep it up for a long time yet. I hope the present series will in due course reappear as a handy volume like the earlier ones.

London W1. JOHN H. AHERN.

WHAT IS IT ?

SIR,—The accompanying picture is of a peculiar old engine in my possession. It is a single-driver in the now-extinct gauge of 2 in., with a 4-2-2 wheel arrangement, and an 8-wheel bogie tender.

I do not know what it represents, but it is beautifully painted in the attractive colours of the GNR. The cab is fitted with coupled steam valves on the cylinders, water gauge and level cock. The firing is by ordinary four-burner plain-wick spirit lamp.

The stroke is $\frac{15}{16}$ in., but as the ends of the cylinders are fixed on, it is only possible to guess at the bore, which is about $\frac{1}{2}$ in. or less. Slip eccentrics are fitted on the driving axle outside the drivers and between these and the cranks.

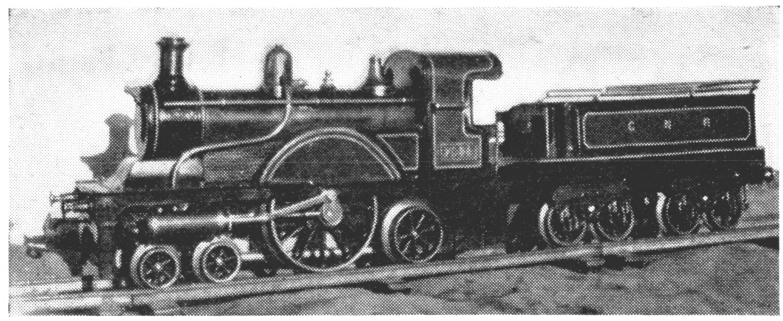
There is a considerable amount of brasswork and this, when polished, makes a very fine show with the green livery and maroon footplate. It has been much admired by many people.

This old set may be considered only a toy of, perhaps, 50 years ago, but the workmanship and material are beyond reproach, and a joy to behold.

I know of a clockwork 0-4-2 locomotive of the GNR, with two bogie coaches, and quite a small oval of track in this gauge, for which more than £25 was offered. In my set there is also a bogie sleeping coach with interior fittings; there are two four-wheel coaches, one in GN green, the other in brown. There is also a quantity of tinplate track, some turnouts, a station building and a viaduct, and a footbridge with signals, all of quite elaborate construction.

On the front of the engine is a transfer which has become partly obliterated, but upon which are, I think, the letters G.B.N. They most likely stand for George Britain, of somewhere.

Greystones, Co. Wicklow. M. K. HUGGARD.



Any suggestions ? Mr Huggard will welcome your views

O GAUGE LOCOMOTIVES

SIR,—I think your correspondent in the issue of April 10 has been a bit hard on LBSC's Beyer-Garratt.

Admittedly it is for the younger generation, but if something more ambitious is required our advertisers can supply castings and prints for *Bat*, *Sir Morris* and *Mollyette*. What is the value of a *Bat* ?

I do not suppose that any model maker would care to supply one in steam, and subject to a satisfactory trial, for less than £50 and a coal-fired *Sir Morris* would come out considerably more expensive. Surely no one would care to hand over such a valuable little engine to the tender mercies of the younger generation ?

The Beyer-Garratt seems to fill their bill exactly. Incidentally, the clearances are cut very fine in this design and require exact workmanship, so I do not think a model maker need be ashamed of a completed locomotive.

Model engineering has so many facets that it ill behoves any of us to deride another's interest, but speaking purely personally I would not bother to turn round to look at a steam outline electrically driven locomotive.

A genuine electric train is another matter, though not my hobby. I would not venture an opinion as to whether simple engines appeal to the younger generation. They, at any rate, have not had much of an opportunity to judge for themselves. The only steam engines I have seen lately in the shops have been stationary engines with microscopic cylinders and costing nearly £3. In my early days in the mid-nineties I can remember the immense pleasure at seeing a friend's railway with a simple German oscillating cylinder locomotive. Later at school the boys were allowed to run their locomotives in the gym on wet Saturday afternoons, most of them being fair-sized engines, British built with bright copper boilers. The gym was always crowded on these occasions with enthusiastic onlookers. I had an *Ajax*, which is occasionally referred to in ME but it was poorly made and I hardly got a run out of it.

At this time the German engines were coming in from Nuremberg in an immense variety of steam, gas, hot air and vacuum engines and whatever may be said against them, they were made with a considerable degree of precision. Among the many that I had, I remember an oscillating cylinder locomotive (12s. 6d.) and a slide valve locomotive at 26s. Both ran well for many years and gave great pleasure to us and our families. Fairly recently I found in a junk shop the remains of a very superior four-

POSTBAG

The Editor welcomes letters for these columns, but they must be brief. Photographs are invited which illustrate points of interest raised by the writer

CRAFTSMANSHIP

SIR,—Your issue of April 24 and the report by Joseph Martin on the Northern Models Exhibition cannot pass without comment.

He grumbles: " Many of the models have been seen before "—well, so what ?

Good craftsmanship is worth showing over and over again. Does he want conveyor belts and automation in model engineering to satisfy his desires, or would he prefer a display of hurriedly assembled do-it-yourself kits ?

Mr Martin goes on in his report to mention the Harrow and Wembley Society's exhibits. May I, having had the honour of serving this society as chairman for the past 15 years, state that I am neither a captain nor an American, and furthermore, no exhibits by our society were entered.

I feel this report must have been written while Mr Martin was suffering from the effects of that porridge.

If you are engaging the same correspondent for future Northern Exhibition reports I should personally be pleased to supply him with a packet of salt or the address of a good hotel in Manchester, then he may not take such a jaundiced view of other people's efforts.

Pinner, Middx. C. R. JEFFRIES.

Joseph Martin writes:

What Mr Jeffries appears to be suffering from is an inability to read. I wrote of " exhibits that could have stood in any company "; I mentioned that the locomotives in particular " made a handsome display "; I expressed pleasure in the " old loyalties "; and I concluded with a tribute to the " quiet integrity of craftsmanship " evident in the exhibition.

Ignoring all this—and ignoring, too, the very first need of any annual exhibition anywhere—Mr Jeffries settles like an angry wasp on my comment that too much in the show had been seen before. By an amazing feat of logic, he translates this into a preference for conveyor belts, automation and do-it-yourself kits ! How anyone could form this impression after reading my article is completely beyond me. Most of my work is in praise of live steam, little railways, and old ships.

Mr Jeffries has also discovered his name in an article where it does not appear at all. The passage mentioning Captain Moroney, who is an American, refers expressly to the Metropolitan Ship Model Societies and not to any model engineering society as such. All the information is as supplied.

While I am grateful to Mr Jeffries for his kind offer, it may interest him that the hotel was one of the best in Manchester.—EDITOR.

STILL FIRST CLASS

SIR,—My two photographs were taken at the Woburn Abbey traction engine rally held last year. Both these little showman's engines were built by William Foster and are still in first class condition.

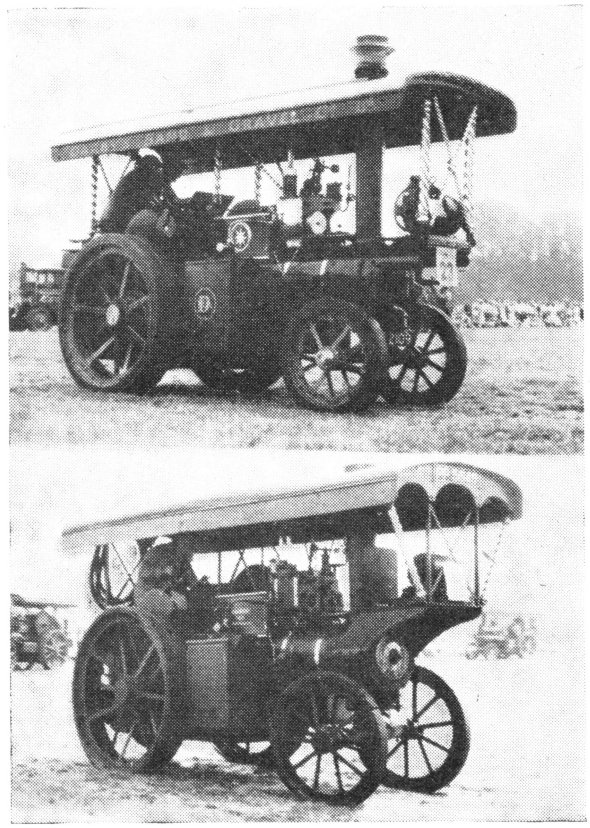
London SW4. B. MATTIMORE.

PLUG CLEANING

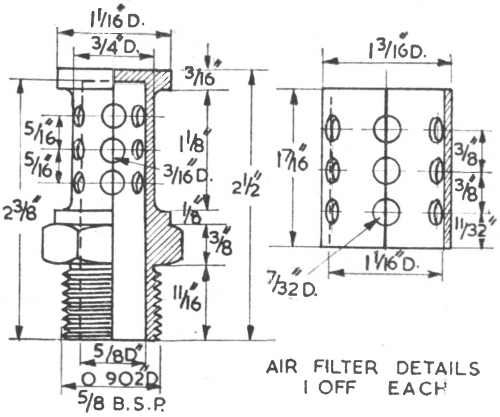
SIR,—I have read with interest, the article by Nixon in your issue of April 24 in which he deals with the problem of the un-clean plug.

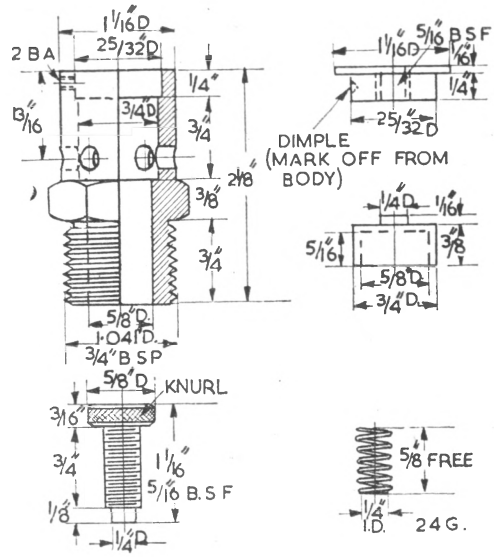
Mr Nixon might be congratulated on the amount of work he has put into the subject, but for myself, and possibly because I am a chemist rather than an engineer, I have approached the problem from an entirely different angle.

I am well aware that the sand-blasting of plugs is standard commercial practice, but nevertheless it is cheap and nasty though a rapid method of achieving the desired end and is unsatisfactory for two reasons.



Two small showman's engines photographed by Bernard Mattimore





must be protected.

The turning is straightforward. Use a knife turning tool for turning the 1 in. dia. and a round-nose tool for the $\frac{3}{4}$ in. Turn the 1 in. dia. so that the sleeve will just push on.

When the diameters are finished, before removing the job from the chuck, index the positions of the holes by any convenient method.

I have described a simple method in previous articles. Place a suitable piece of material about 3 in. long between one of the chuck jaws and the lathe bed and, holding the chuck firmly against the block, draw the turning tool along the $\frac{3}{4}$ in. dia. Repeat this process at each jaw to obtain three equally-spaced lines. The positions of the three holes on each line can also be marked.

Use a turning tool with a point like that used for screwcutting, locating it centrally between the two ends of the $\frac{3}{4}$ in. dia. Feed the cross slide in until the tool just touches, then turn the chuck by hand, making a line to intersect the previous ones. Repeat this at $\frac{5}{16}$ in. centres on either side of this line. All the intersection points can now be centrepopped ready for drilling.

Relief valve

Remove the body from the chuck and drill all the positions with a $\frac{3}{16}$ in. drill. Run the drill right the way through the $\frac{3}{4}$ in. dia., so that when the drilling is finished, you have three rows of six holes.

The outer sleeve, which requires little attention apart from facing the ends to length, can also be treated in similar fashion in the marking and drilling of the holes. The material used for the filter element is steel wool soaked in lubricating oil.

Now for the last item, the pressure relief valve. Grip the piece of material in the three-jaw chuck and face the ends to size as before. Then centre-drill one end, and run a $\frac{3}{16}$ in. drill right through. Follow this with a $\frac{3}{8}$ in. and then a $\frac{5}{8}$ in. Once again, in the absence of a $\frac{5}{8}$ in. drill, use the largest you have and finish with a boring tool.

Now turn the outside diameter for the $\frac{3}{4}$ in. BSP thread. An ordinary knife turning tool can be used for this, the diameter being left on the plus side of about 10 thou.

I left the cutting of the thread to the very last; this little extra allows for a light cut to be taken after chucking to make sure it's true. When you have turned the diameter, remove it from the chuck and hold it by this diameter for the next turning operations. Turn the outside diameter to $1\frac{1}{16}$ in. with the same tool as you used before.

The next operation is boring the top end; the drilled hole that you made at the previous chucking will be a good start for the boring tool.

Taking light cuts, feed the tool to a depth of 1 in. and open the hole out to $\frac{3}{4}$ in. in diameter. When on the final cut, take particular care that you leave a sharp right angle corner at the bottom so that the valve can sit properly on a flat surface. When complete, open the end up still further with the boring tool to 25/32 in. dia., $\frac{1}{4}$ in. deep, finishing to a sharp corner to allow the adjusting screw plate to sit properly. This plate is a light press fit into the bore and is held in place by a grubscrew.

Some readers may question the reliability of this method, and may consider that a thread would be a better proposition. I used the press fit in preference to a thread because it is much quicker to make; it would be necessary to screwcut the thread, and this fitting does not have to withstand high pressures. In service it has worked very satisfactorily. If a screwed fitting is preferred, leave a little extra on the outside diameter ($1\frac{1}{16}$ in.) to allow for the depth of thread.

When you have completed this part of the work, mark the positions of the vent holes before removing from the chuck. To do this accurately, put a knife tool with a sharp end on the topslide and set the graduated collar at 0. When doing this, make sure you can traverse the topslide a full 1 in. and not something short of it. Then run the tool up to the end of the workpiece with the saddle. When it touches, lock the saddle, and with the tool clear from obstruction traverse it along on the topslide 1 in.

Equally spaced holes

Feed the tool in until it touches the work, and then turn the chuck by hand so that the tool makes a clear line right round. Graduate the line into three equal parts in the same way as was used on the air filter. Centrepop where they intersect, and when drilling take the drill right through so as to produce six equally spaced holes.

When the holes are drilled, return the workpiece to the chuck for the cutting of the thread. Adopt the same procedure as that used when screwcutting the air filter, the same gear train can be used because $\frac{5}{8}$ in. and $\frac{3}{4}$ in. BSP are both 14 t.p.i.

The valve for the body can be made from a piece of solid material or fabricated from a piece of $\frac{3}{4}$ in. o.d. tube with a cover soldered on one end.

The end cover plate for the adjusting screw is a straightforward turning operation. Particular care should be taken when turning the 25/32 in. dia. ▣

IN THE ME WORKSHOP

Brazing hearth and forge

With the air filter and pressure release valve EXACTUS completes his simply-built apparatus

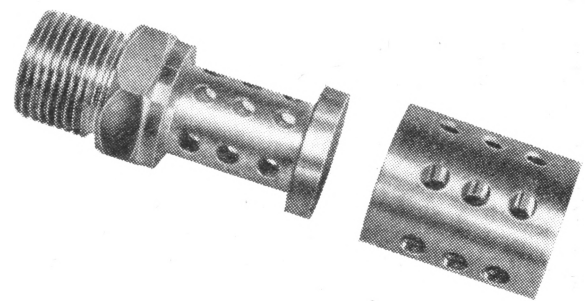
THE plumbing, or pipework, brings me to the final details of this forge. As I mentioned earlier, nearly all the items required are obtainable from a builder's merchant.

Parts required will be as follow: two $\frac{3}{4}$ in. to $\frac{5}{8}$ in. BSP reducing nipples, one $\frac{3}{4}$ in. BSP coupling, two $\frac{3}{4}$ in. BSP T-pieces, one $\frac{3}{4}$ in. BSP elbow, three $\frac{3}{4}$ in. BSP running nipples, one brass gas tap with $\frac{3}{4}$ in. BSP female ends, one $\frac{3}{4}$ in. BSP blank end cap, one $\frac{3}{4}$ in. BSP locknut, and one brass gas tap $\frac{5}{8}$ in. BSP with end for rubber pipe connection.

I bought all these items for just over 30s. The most expensive of them is the $\frac{3}{4}$ in. BSP brass tap for controlling the flow of air to the forge. Any reader who cares to make his own will cut his cost by about a third.

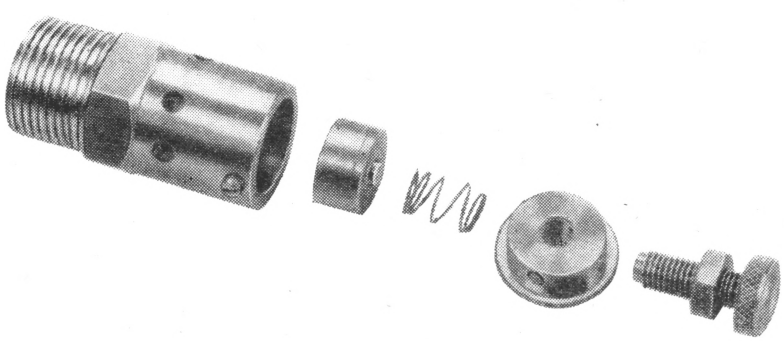
It is hardly necessary to say much about assembling the parts, because it is only a question of screwing them together. The only part that will require a little attention is the end cap. Cut three slots in it for releasing the air to form the nozzle inside the hearth. I used a machine hacksaw blade in the handsaw frame; this gave a wide slot at one cutting. The same result can be obtained just as well by inserting two or three ordinary hacksaw blades together.

The two items which have to be made are an air filter for the blower and a pressure relief valve. If you were unable to get a $\frac{3}{4}$ in. to $\frac{5}{8}$ in. BSP reducing nipple you will, of course, have to make this also. I made all my fittings from brass, but this is not absolutely necessary; mild steel will do just as well; a coat of paint on the finished job will prevent rust.



The air filter for the blower without element

Both the filter and valve are made from hexagon bar, measuring $1\frac{1}{8}$ in. across the flats. Cut two pieces, one $2\frac{1}{4}$ in. long and the other $2\frac{5}{8}$ in. The latter is for the air filter; to make a start, face both ends so that the piece of material finishes $2\frac{1}{2}$ in. in length. The next job is to bore the centre out $\frac{5}{8}$ in. in diameter, $2\frac{3}{8}$ in. deep. Start off in the usual way with a centre drill and follow this with a $\frac{1}{8}$ in. drill, taking it $2\frac{3}{8}$ in. deep.



Parts of the pressure relief valve

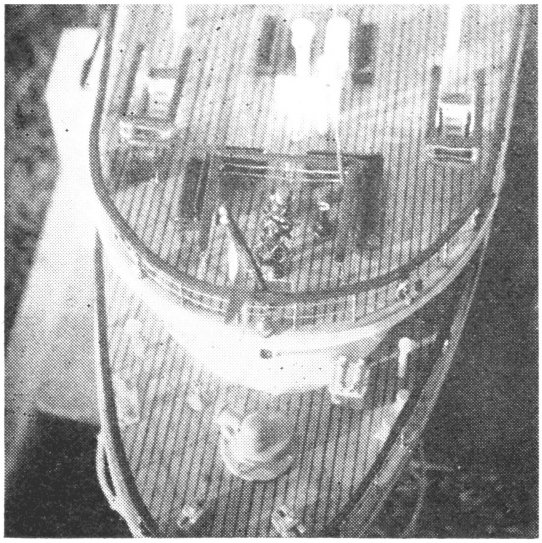
As nothing has to fit inside the finished hole, the exact size is not all that important, so a $\frac{5}{8}$ in. drilled hole will do quite well if you have a drill this size. Otherwise it will mean using the largest size drill you have and finishing with a boring tool. To make the work easier, whatever method you use, open up the $\frac{1}{8}$ in. hole with another drill, about a $\frac{5}{16}$ in., before using the larger drill.

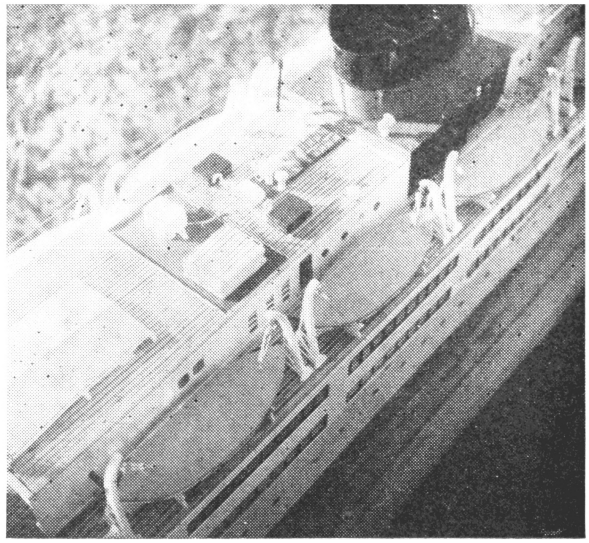
The next operation, while the job is still held in the chuck, is to turn a 0.902 in. dia., $\frac{3}{4}$ in. long, to take a $\frac{5}{8}$ in. BSP thread. An ordinary turning tool will do this; a small undercut should be made at the shoulder to allow the body of the filter to sit squarely in the blower casting. Use a parting tool to turn the undercut.

The first thing to do to begin screwcutting is, of course, to set the correct gear train and then to grind the turning tool to the correct form, which is the same as for a Whitworth thread, namely 55 deg. inc. Set the tool on the topslide in the correct position with the help of the thread form gauge.

In my article on February 20 (page 245) there is an illustration showing this set-up; the same method applies to all screwcutting operations. The core diameter is 0.811 in., which means that the tool has to be taken 0.0455 deep. If you take a careful check of the cross slide index from the start and cut to a depth of 46 thou, the thread will fit into the tapped hole without further adjustment.

The next operation is the reducing of the body to take the filter element. For turning, the workpiece can either be held on a stub mandrel which fits the $\frac{5}{8}$ in. bore, or be gripped in the three-jaw by its thread. If the second method is used, however, the thread





plastic lenses, stove chimneys, Gradwell floats, Carley rafts, DF loop, radar scanner and fire buckets.

Mersey Marine Navigator electric motors with 3½ in. to 1 in. reduction gears drive 2 in. dia. propellers. I cannot speak too highly of these motors, the torque is terrific !

The current is supplied from two 12 v. accumulators, one to each motor. It was necessary to add a considerable amount of internal ballast in the form of a lead sheet to bring her down to her marks.

The model is very stable, and the speed more than adequate.

All rigging is set up with dummy rigging screws, heart thimbles, and U-shackles. The house flag, a white Maltese cross on a blue ground, is flying at the main.

I made most of the fittings. There are no less than 128 parts in the luffing davits alone, but as I have no workshop, and have to do all my building on the kitchen table, I had to buy the brass stanchions, blocks, gratings and plastic portholes.

For the first time I kept an accurate check on the cost of everything. The total cost was rather staggering, £68 17s. 8½d. ! Perhaps it is best not to know !

The building time, including drawing plans to my own scale, was just eleven months. I worked on an average five evenings a week, about three hours each time, and I enjoyed every minute of it ! ▣

Gas blowpipe

By H. S. FOX

From time to time I have seen queries about gas torches but have never seen any constructional details of one. This one described, was used to braze half of *Maisie's* boiler and will fulfil the desires of many readers.

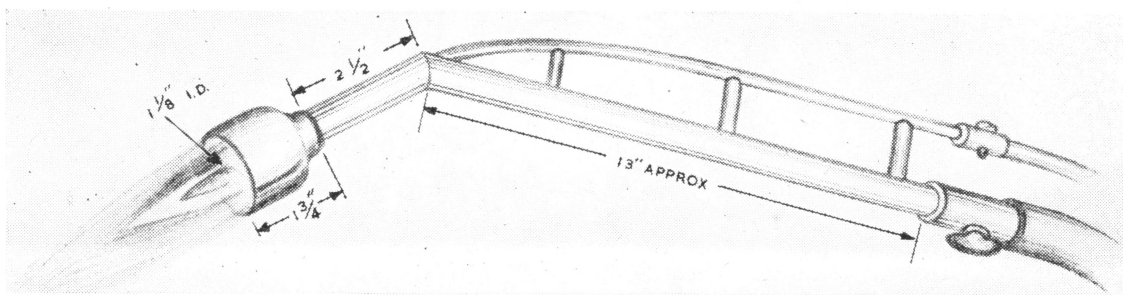
Copper tubing is used, but brass or steel will also be suitable. The gas and air tubes are ¼ in. × 15 in. long and the spacers are ¼ in. thick. The end was sawn and bent to an angle of about 70 deg., then a hole is drilled in the top for the gas tube. All the pieces are cut and silver soldered having first been bound with wire.

The nozzle needs no explaining and is made of one piece of 1⅜ in. brass rod. The gas valve is an ordinary ¼ in. pet, or drain cock, and the drip end is ¼ in. silver soldered to the gas pipe and threaded to the ⅛ in. pipe thread. The air valve is made from a 1 in. square brass bar stock, drilled through $\frac{7}{16}$ in. and then bored with a ⅝ in. hole, at right angles, ⅞ in. from one end. This gives a flat bottomed hole with 1/32 in. left.

The plug is a piece of ¾ in. brass stock, turned to fit the flat bottom hole in the body, just clear of the bottom. The handle is of $\frac{1}{16}$ in. brass sheet filed out and silver soldered into a light saw cut. The bottom is tapped 3 BA and a screw is made to keep the plug in the body. A spring washer completes the valve.

Air is supplied by an old vacuum cleaner stripped of all accessories. I made a hard wooden plug for the discharge end, with a piece of copper tubing pressed in the centre for the rubber hose with a wooden box packed with steel wool for the air to enter. This reduces noise.

This torch will do all the jobs anyone will require within reason and is easy and clean to operate. A point to remember is to switch on the motor first, and then open the gas. The valves can be set for the flame and left in that position. When finished shut off the supply first, and then the torch. ▣



The Kronprinsesse Ingrid

whose shipbuilding yard was the kitchen table !

By D. W. Greenslade

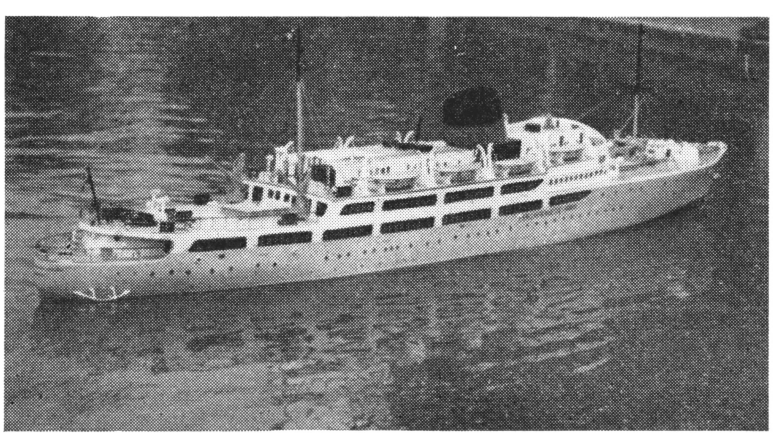
THE Danish motor vessel *Kronprinsesse Ingrid*, is a fast modern ship, which, together with her sister ship *Kronprins Frederik*, maintain the service between Harwich and Esbjerg.

Both vessels are twenty and a half knot ships and they measure 353 ft. The gross tonnage of the *Kronprinsesse Ingrid* is 3,968.

I expect readers will remember that the *Kronprins Frederik* caught fire at Harwich in April 1953, and was almost a total loss. She was salvaged, however, and after extensive reconstruction, was put back into service in May 1954.

I so admired the beautiful lines of these ships, that when I first saw photographs of them in a travel agent's window, I made up my mind to build a model of one if I could get the plans. In response to my request the owners (The United Shipping Company of Copenhagen) kindly lent me all the necessary drawings, and some helpful photographs. They also gave permission for a friend of mine to visit the vessel at Parkeston Quay to take photographs. In all, I collected over 40 photographs showing various details. I am indebted to Mr Moffatt of the Ipswich Nautical Research Society for sending me much information about the ship also.

The model is built to my usual scale of $\frac{3}{16}$ in. to 1 ft, and is a large model measuring 5 ft $10\frac{1}{4}$ in. overall. I have tried to reach exhibition standard, and although a working model, she is complete in every detail, except for slightly simplified rigging, to give easy access to the electric motors and accumulators.



The hull is built of obechi planks bread-and-butter fashion, joined with resin glue. The superstructure is made of 2 mm. and $\frac{1}{16}$ in. resin bonded ply, on obechi frames. All deck planks were laid individually with thin strips of black card cut with a sharp knife and steel rule, which were laid between each plank to give the impression of pitch.

The finish, always the hardest part, and the most expensive, is of brushing cellulose. Nine coats of red primer were applied first, rubbed down with wet or dry paper, used wet. The three coats of appropriate undercoat were brushed on, followed by two finishing coats. The hull is painted with red oxide boot, very light grey topsides and white superstructure. All planked decks are banana oiled. The derricks and masts are light brown, the masts having black tops above the mast tables. The big tapering funnel is made of sheet copper and is red with a black top.

A bow badge made in relief, consisting of a buff anchor surrounded by an anchor chain, also buff, superimposed over a white Maltese cross on a blue ground, is fixed to the rounded stem. The stanchions are silver, and the cranes, winches and windlass grey.

The fittings include an anchor windlass, fire winches, electric capstan, wire compressors, hatches, gratings, flood lights, navigation lights with

This free advice service is open to all readers. Queries must be of a practical nature on subjects within the scope of this journal. The replies published are extracts from fuller replies sent through the post: queries must not be sent with any other communications: valuations of models, or advice on selling cannot be given: stamped addressed envelope with each query. Mark envelope clearly "Query," Model Engineer, 19-20 Noel Street, London W1.

READERS' QUERIES

DO NOT FORGET THE QUERY COUPON ON THE LAST PAGE OF THIS ISSUE

Frequency change

I would appreciate very much if you could please give me some help with my problem, viz. a new ¼ h.p., 25 cycle, 110 v. motor (single phase) which I found in a junk yard and wish to change to a 60 cycle.

I have done some mechanical repair work on motors and have seen many 25 cycle motors changed to 60 cycle. In the case of smaller motors—¼ or ½ h.p. it is mostly done by a trial and error method. What is a general rule to follow to get a near correct amount of copper for the amount of iron present in the motor to be rewound and could you please state size, weight, or length of wire required for both starting and running winding for the above motor, which has 24 slots in the stator. The starting switch spring will have to be changed to give the correct running speed.

Could you give me the name of a book, or books that give information on rewinding fractional horsepower motors?—J.R.MacL., Glace Bay, NS.

▲ *Calculations of motor rewinding are not carried out on a trial and error basis: this could only happen in a shop inexperienced in redesign. For your conversion the number of poles must be doubled, and the winding for the alteration will be 90 per cent of the existing turns per slot, distributed over the new slot arrangement. These data apply to machines having wound rotors as well.*

There are a number of useful books on winding small electric motors, published by Percival Marshall and Co. 19-20 Noel treet, London W1, but none of these publications would give data on frequency changes. This information will only be found in standard textbooks on alternating current motor design and construction. The MacGraw Hill Company of America would be a suitable house to inquire for such publications.

Dolphin 10 c.c. four-stroke

As a regular reader of MODEL ENGINEER I have recently become interested in the 10 c.c. general purpose four-stroke petrol engine designed and detailed by E. T. Westbury. The intended use is to propel a metre class motor launch which, incidentally, is radio controlled. Would you kindly advise the following details:

1 Are castings still available—if so, please state source of supply. 2 Would the magneto marketed by Electronic Developments Ltd, be suitable for this engine and is a complete magneto, in fact, still available from that company? 3 Being installed in a launch type hull (similar to *Streamlinia* by Bassett-Lowke), would you consider air flow to be sufficient to ensure adequate cooling? 4 Is there a design available for a water-cooled cylinder?—B.P., Wednesbury, Staffs.

▲ 1 *Castings for the Dolphin 10 c.c. general purpose four-stroke can be obtained from W. H. Haselgrove, 1 Queensway, Petts Wood, Kent.*

2 *We understand that the M.I. Magneto, formerly marketed by ED Ltd, is no longer available. If, however, it can be obtained this could be used for ignition on the Dolphin engine*

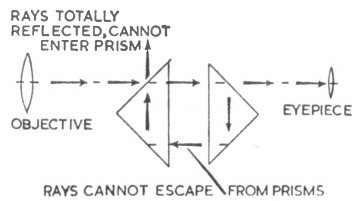
3 *An air-cooled engine cannot be satisfactorily employed in an enclosed hull, but it is usually possible to arrange an air scoop of adequate dimensions to direct the air flow on to the engine. It is better still to fit a fan on the engine with a cowl or air duct to supply forced cooling.*

4 *There is no design at present available for a water-cooled cylinder to suit this engine, but satisfactory water cooling can be obtained by turning off all the fins except the top and bottom fins and brazing on a brass or copper tube to serve as a water jacket.*

Monocular telescope

In your excellent Diamond Jubilee issue there was an article on the construction of a high power monocular telescope by Kinemette.

In this design the prisms are at 90 deg. to each other. Could the prisms be placed at 180 deg. to each other? If they could, the overall width could be cut down. This would make the monocular much more convenient to carry in the pocket.



This modification would most probably complicate the design but I am sure that I can get over the mechanical problems.—P.T.G., Pontypridd, Glam.

▲ *With reference to the high power monocular telescope described in the May 1 issue, it is not practicable to place the prisms at 180 deg. to each other as you suggest. A little thought will show the reason why.*

The prisms must be placed at 90 deg. so that the path of the rays into one prism and out of the other does not cross.

By placing the prisms at 180 deg. one prism would obstruct the ray from getting to the other at all, but assuming it did, it would just be reflected back from the second prism and would not get to the eyepiece.

Vane gear

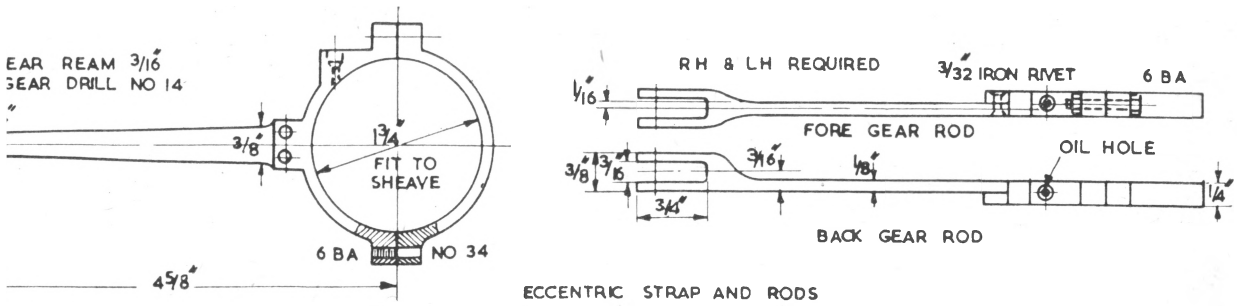
With reference to the Lassel self-tacking vane gear I should be very pleased if you would supply me with the following information: 1 What part of the sail rigging is attached to the guy hook adjustment bowser? 2 What is the function of the cam? 3 Can you tell me what the disc with 16 holes shown is for? 4 What is the function of the centring latch?

I am building a model of *Witchcraft*, a Bermuda rig racing yacht. I should like, as a regular reader of MODEL ENGINEER, to thank you for an interesting magazine.—G.R.C.R., Weston-super-Mare.

▲ *There are dozens of vane gears and each designer seems to have new ideas although the basic idea is the same. Replying to your queries in order:*

1 *Rigging from the guy hooks is taken to the main boom through guide pulleys or eyes, and has bowser adjustment.* 2 *The function of the cam is not clear. It was thought the cam rivet engaged with the hole in the disc but this is unlikely in view of the screw adjustment.* 3 *The disc is used to set the main bar in the desired relation to the tiller, and the holes are for the pin which determines the relation.* 4 *The centring latch is for locking the vane centre bar and the bar with the counterweight in one straight line.*

Ideas on the vane gear are developing all the time and it is difficult to keep up with them. Perhaps if you could contact someone in the Clevedon or Bristol Model Yacht Clubs he would be able to explain things more fully.



ECCENTRIC STRAP AND RODS

centre point in the tailstock barrel. Hold the casting with one of the pop marks against the centre point and feed it up to the drill, guiding the casting so that the drill enters the other pop mark and drills right through the bearing. Then reverse the casting, and with the centre point in the hole already drilled, drill the other bearing in similar fashion. Finally, put a $\frac{1}{4}$ in. parallel reamer through both holes at once. Drill a $\frac{1}{16}$ in. oil hole in each bearing.

To build up a motion plate, cut a piece of $\frac{1}{8}$ in. frame steel measuring $4\frac{1}{8}$ in. $\times$ $2\frac{11}{16}$ in. and take care that the sides are at right angles to top and bottom; check carefully with a square. File top and bottom edges to shape shown, then rivet a $2\frac{1}{4}$ in. length of $\frac{1}{8}$ in. $\times$ $\frac{3}{16}$ in. angle along each side. Cut the two openings for the connecting rods to pass through by drilling and filing; the supports for the guide bars can be made by riveting $\frac{3}{16}$ in. lengths of $\frac{5}{16}$ in. $\times$ 3/32 in. angle at top and bottom of each opening, as shown by the dotted lines.

The rocker bearings can be sawn and filed or milled up from $\frac{3}{4}$ in. $\times$ $\frac{5}{16}$ in. bronze or gunmetal bar (cast or drawn) and after drilling, attached to the motion plate in the position shown by two 5 BA screws—any shape of head available—running through No 30 holes in the motion plate into tapped holes in the bearings. Ream $\frac{1}{4}$ in. after assembly, but don't erect the motion plate permanently yet, as it is easier to fit the rocker gear before erection. Just set it in place at right angles to the guide bars, with the bars passing through it and resting against the lugs, and the holes in the rocker bearings 1 in. below the centre line of motion and $4\frac{13}{16}$ in. ahead of the centre of the driving axle.

Run a No 21 drill through the holes in the frame and make countersinks on the side flanges of the motion plate. Run a No 34 drill through the holes in the guide bar lugs and make countersinks on the guide bars. When doing this, run the crossheads up between the lugs to support the bars. Then remove the motion plate and drill the countersinks No 30, tapping 5/32 in. or 3 BA. Remove the guide bars, drill the countersinks No 44 and tap 6 BA. Alternatively, drill No 34 and counterbore the rubbing sides to a full $\frac{1}{16}$ in. depth with a $\frac{3}{16}$ in. pin-drill. Replace the bars.

The eccentric straps should be cast in good quality bronze, or in this size cast iron might be used. Cast iron works very well on steel sheaves, and the wear is very slight; it is used in full-size practice, but needs adequate lubrication. Clean the castings with a file, then drill the holes through the lugs with a No 44 drill as described in the "Ways and Means" article. Scribe a line across the centre, grip in the bench vice with the marked line just showing, and saw across with a thin fine-toothed hacksaw. Open out the holes in the ring half with No 34 drill, and tap those in the other 6 BA.

Completion of connecting rods

To complete the connecting rods (p. 700), the bolts can either be ordinary commercial $\frac{1}{8}$ in. bolts of the size shown or made from pieces of $\frac{1}{8}$ in. silver steel a full $1\frac{5}{8}$ in. long, the head end being screwed for a full $\frac{1}{8}$ in. length and furnished with a nut, riveting the end of the screwed part slightly over the nut to keep it permanently fixed.

Put the bolts in and nut them up tightly. Now be careful over this bit. Exactly in the middle of the joint, make a centrepop, drill a small pilot hole, say No 30, open it out with a 47/64 in. drill, and ream $\frac{3}{4}$ in. Countersink the hole very slightly on both sides, just sufficient to take off the sharp edges. The important point to watch is that the hole goes through dead square with the sides, or else you'll have the driver's nightmare again, hot big-ends.

Returning to the connecting rods, after reaming take out the brasses, make a mark on each half so that they can always be replaced in the same position, then heat them until the halves fall apart. Wipe off all the solder so that the joint is perfectly clean, and replace in the strap ready for erection when the valve gear is being fitted.

The assembly drawing shows how the cylinders should be erected. The centre line of the bores should be $1\frac{1}{16}$ in. below the top of the sloping part of the frames at the leading end, and the vertical centre line should cut across the middle holes in each line of screwholes. If these have been drilled in correct location according to the frame drawing, the cylinders will then occupy their right place in the frames.

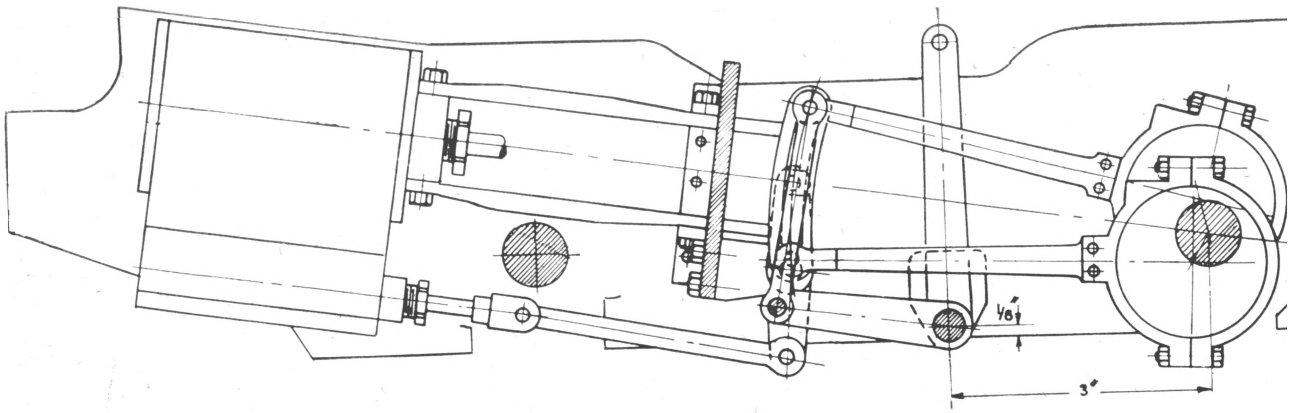
Put a big cramp over the outsides of the frames to hold the cylinders in position. Before drilling and tapping the screwholes I usually have a final check by pulling out the piston rod as far as it will go, and putting a perfectly straight piece of tube over it, which should be a close fit. This tube should pass exactly central between the crank webs, and cut right across the centre line of the axle.

Put a No 21 drill through all the holes in the frame and make countersinks on the sides of the cylinder casting. Remove the cylinders, drill No 30 at the countersinks for about $\frac{3}{8}$ in. depth, and tap 5/32 in. or 3 BA. Note, if using the BA size screws, the holes in the frame should be opened out with a No 19 drill before putting any screws in, as that is the correct 3 BA clearing size. Don't erect the cylinders permanently yet, as they will have to be removed when fitting up the valve gear.

The drawing also shows what a tight squeeze it is to get the guide bars and valve crosshead clear of the front axle. There is only just enough room, but "enough is as good as a feast." Anyway, it has all panned out satisfactorily.

The rocking levers for the valve gear will work in brackets attached to the motion plate; the upper ends carrying the die blocks will be on the centre line of motion which allows the specified arrangement of rods, links, lifting gear, etc., to be the same as in full size, while the lower ends will be in line with the valve spindles with straight rod connection. The more straightforward a job is the better it will work!

● *To be continued*



ELEVATION & PLAN OF VALVE GEAR

links, owing to the rocker arm and bracket, and so I had to make do with one only. This is the same as I fitted to *Grosvenor*, and it works quite all right.

As a matter of fact, many of the GWR engines with outside cylinders and inside valve gear, such as the Halls, Granges and so on, have lifting links at one side only of the expansion link, the other side being obstructed by the suspension lever carrying the die-block.

The pendulum lever on the outer end of the rocking shaft lines up with the valve spindle, so all that is needed is a plain rod with a fork at one end only, like a combination lever, which embraces the end of the pendulum. The other end fits the slot in the valve spindle fork, as shown in the plan drawing. This corresponds to the valve spindle drive from the pendulum levers on the outside cylinder Halls and Granges, so we aren't departing from Swindon tradition !

The weighbar shaft is carried in two brackets attached to the side frames as in full size, and has the same long reversing arm at the right-hand end; but there is only one lifting arm. As the two lifting links are side-by-side, it is more convenient to carry them in a single arm with a fork at the end, and this, as it so happens, is an advantage. Owing to the longer expansion link, the back-gear eccentric rods drop lower down when the engine is in full forward gear, and would have been perilously close to the usual double arms.

As it is, the single arm is quite clear of the rods, and in full forward gear they are still $\frac{1}{8}$ in. above the weighbar shaft. Just to make certain of this, I cut out a paper expansion link and two eccentric rods, and with the aid of domestic pins tried the gear in its working positions. They don't do that at Swindon, but it works jolly fine at Purley !

Motion plate

The end view of one side of the valve gear erected shows that there is nothing to run foul of the connecting-rod, and although there is no flange or other means of keeping the die-block in the slot in the expansion link, the latter can't run off the die-block, as it is prevented from playing tricks by the lifting link on one side and the rocking lever on the other. I guess that explains all about the milk in the coconut; so now to details.

The motion plate may be cast or built up, as desired. If cast, it will have the rocker bearings and the lugs for attachment of the guide bars integral. The sides can be machined up to fit nicely between the frames by exactly the same process described for the frame stay. Anyone who has a planing or shaping machine can grip the casting in the machine vice and plane off the contact faces of the guidebar lugs with a bent tool in the clapper-box. The sides of the rocker-shaft brackets may be given a dose of the same medicine.

Note that the brackets or bearings should be $\frac{5}{16}$ in. wide, and that the outer sides should be 3/32 in. off the centre-line, so that the pendulum arms will line up with the valve spindles; but there is no need to go into four places of decimals ! Failing machining facilities, careful filing will do.

Two No 34 screwholes are drilled in each guide bar lug, for the 6 BA screws securing the outer ends of the bars. A 15/64 in. hole (or letter C drill can be used) is drilled in each rocker bearing at 1 in. below the horizontal centre-line and $\frac{13}{16}$ in. from the back of the casting. These must go through dead square with the machined sides of the casting, so set it very carefully by aid of a square in the machine vice on the drilling machine table before putting the drill through.

If using the lathe to do the drilling job, first carefully mark out and centrepop the location of the holes on the outer sides of the bearings. Put the drill in the three-jaw, and the

PANSY

LBSC begins his description of a Stephenson link motion for the GWR pannier tank engine

IT is with one big sigh of relief that I now present the reproduced drawings of a suitable valve gear for our *Pansy*. Scheming it all out has been one of the trickiest jobs that I have undertaken for many years past.

I have a 3 in. scale drawing of the motion of the full-size locomotives, but that is arranged for valves between the cylinders, and it also doesn't provide sufficient valve travel for the little engine. As the valve spindles pass through the motion plate in full size, the gear is direct-connected and very straightforward, like all Swindon designs—up to the time that they started on building diesels ! Adapting the valve gear to operate valves below the cylinders was a horse of another colour.

Maybe it would be as well if I described the general layout of the gear before going into details of construction. When first designing the cylinders I discarded any idea of adopting the inclined portface of the LBSCR Gladstones, or the GER *Petrolea*, as the arrangement of the GWR guide-bars pushed the cylinders up so high that a casting with inclined portface would have been too big and unwieldy, and would have protruded much too far both in forward and downward directions. This ruled out the arrangement of direct-driven valve gear used on those engines, and with the compact arrangement of cylinders that I adopted the only alternative was to drive through rockers.

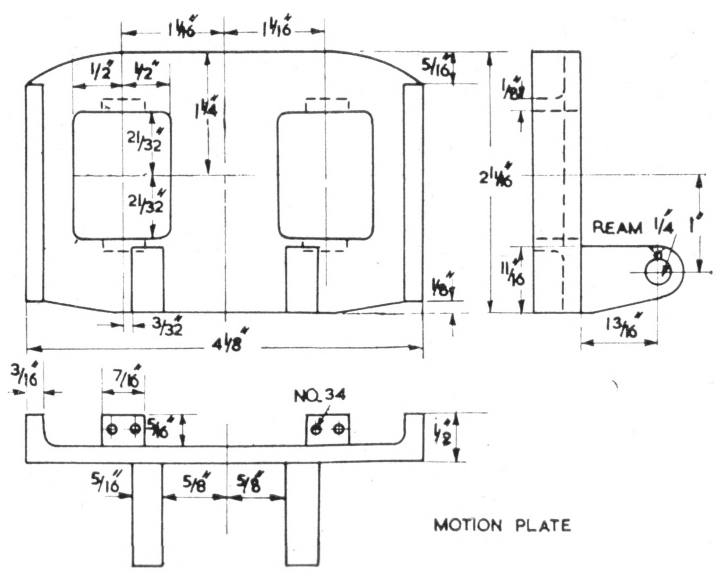
Now that seems simple enough at first sight, but there were two big wasps in the jampot. One was the connecting-rod, which had to be dodged, and the other was the difference in the vertical centre-lines of the expansion links and the valve spindles. That put clean out of court the arrangement of using the type of valve gear that I fitted to *Grosvenor* but turned upside down. I got over both difficulties at one fell swoop by devising a rocking shaft working in a bracket fixed to the motion plate, with a vertical lever at one end and a pendulum at the other. This can be plainly seen in the end view of the valve gear.

How the valve gear operates

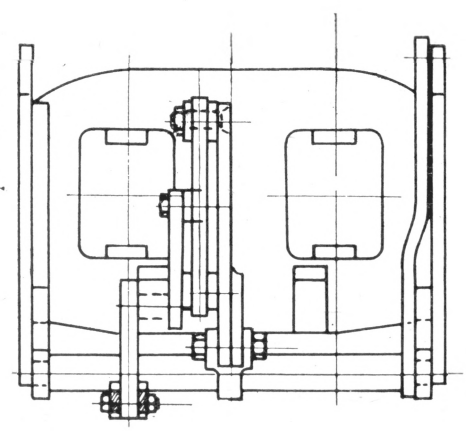
The vertical lever carries the die-block, and as this is on the centre-line of motion it permits the use of the Swindon arrangement of eccentric rods and expansion link, which I worked in with a little modification. The eccentric strap-and-rod assemblies are practically " scale " length, but the eccentric sheaves (or tumblers, as the enginemen usually call them) have a proportionately longer throw, and the expansion links are longer, to bring the inclination relative to their length, about the same as in full-size.

If you have a short link with a big angle of inclination, it is a dickens of a job to reverse the engine if she happens to stop with the eccentrics on the front and back centres. I know of more than one engine which will not reverse at all in that position, and has to be moved until the links move far enough toward the vertical to enable them to slide down the die-blocks.

The full-size engines have a thin lifting link on each side of the expansion link, connected to the pin in the foregear eccentric-rod fork. The weighbar shaft is underneath. I arranged for the weighbar shaft on *Pansy* to be in exactly the same position, but I couldn't fit two lifting



MOTION PLATE


END VIEW LH VALVE GEAR

LOCOMOTIVES I HAVE KNOWN

The GWR City class 4-4-0

A SECOND SERIES

By

J. N. MASKELYNE

THE history of this famous class of swift and powerful 4-4-0 express passenger engine is somewhat involved, and tends to cause considerable trouble to modern historians, who are apt to confuse the City class with its immediate predecessor, the Atbara.

The confusion is understandable by reason of the fact that the prototype of the City class was an Atbara, No 3405, *Mauritius*, which had been reboilered with a standard No 4 boiler in September 1902. The reason for the reboilering was that, although the Atbaras were giving considerable satisfaction on the express passenger services operated by the GWR at that time, Churchwood felt that some extra reserve of boiler power would be an advantage on the heaviest West of England expresses. *Mauritius* with her larger boiler left no doubt about the matter, and an order was placed for ten engines to be built exactly similar.

These were the Cities proper, the first being completed in March 1903, the other nine following in May. They were numbered 3433 to 3442 and named: (*City of*) *Bath*, *Birmingham*, *Bristol*, *Chester*, *Gloucester*, *Hereford*, *London*, *Truro*, *Winchester* and *Exeter*; they were the first examples of what later became the well known Swindon practice of class names for engines. An interesting point is that the last name in the City list comes well out of alphabetical order, and the story is that the last engine was intended to be *City of York*; someone objected to this on the grounds that York was not in the GWR territory, so the name *City of Exeter* was chosen instead.

The Cities were an immediate success and quickly established a reputation for power and speed. A number of record runs was made by them in 1903 and 1904, the best being the scintillating performance put up by No 3440, *City of Truro*, when hauling an Ocean Mails special from Plymouth to Bristol on 9 May 1904. During this run, and for the first time in the history of transport, a speed of 100 m.p.h. was reached, if not exceeded, and was timed by two individuals on the train, quite independently.

One was a Post Office official, the other was Mr Charles Rous-Marten, the well-known authority and writer on locomotive performances. The first published his story in a Bristol newspaper within a few days of the event, but Rous-Marten's log was not divulged until 20 years later, on the grounds that it might have caused alarm to the travelling public !

The postal worker gave 100 m.p.h. as the maximum speed when descending the Wellington bank but his story was discredited; Rous-Marten's log, when it was eventually made public, claimed 102.3 m.p.h. at the same place !

Whatever may be the rights or wrongs of Rous-Marten's figure—it was the subject of considerable controversy about 20 years ago—there seems little room for doubt that the maximum speed was at least 100 m.p.h., and this was the first time that such a speed had been officially recorded. On the strength of this, early in 1931, when *City of Truro* was withdrawn from service, she was not scrapped but sent to the Railway Museum at York for preservation.

Meanwhile, the 4-4-0 express engines of the Badminton class, which were the immediate predecessors of the Atbara, became due for heavy repairs, and the opportunity was taken, between November 1903 and January 1907, to rebuild 16 of them by fitting No 4 boilers; this process made the engines similar to the Cities.

Between February 1907 and March 1910, one more Badminton and nine more Atbaras were similarly treated, by which time the City class consisted virtually of 37 engines, i.e. 17 rebuilt Badmintons, 10 rebuilt Atbaras and the ten Cities proper.

By 1910, however, these engines had become redundant, because Churchward's 4-6-0 engines of the Saint and Star classes had taken control of all the best and fastest trains, and it is not easy to understand why so many Badmintons and Atbaras were fitted with No 4 boilers. However, within the next three years, the rebuilt Badmintons had their No 4 boilers replaced by the smaller and lighter No 2 tapered boiler, and these engines were then assimilated into the Flower class.

The ten rebuilt Atbaras, and the ten Cities proper remained unaltered and put in many years of useful work on secondary express passenger trains. Very occasionally, one would be called upon to take over a top-link turn, and she seldom failed to show something of her old form by putting up a commendably speedy performance. The class was withdrawn from service gradually, over a period of some three and a half years from October 1927, until May 1931.

The principal dimensions of the Cities were: cylinders 18 in. × 26 in.; bogie wheels, 3 ft 8 in. dia.; coupled wheels 6 ft 8½ in. dia.; wheelbase 22 ft 6 in. divided into 6 ft 6 in. plus 7 ft 6 in. plus 8 ft 6 in.; the overhang was 2 ft 6 in. at the front and 4 ft 6 in. at the back.

The boiler was made in three rings, the front one of which was cylindrical, 4 ft 10¾ in. dia. outside; the other two rings formed a cone tapering uniformly to a maximum of 5 ft 6 in. dia. where it joined the firebox; the length of the barrel was 11 ft, and its bottom line was horizontal throughout its length. In the days before superheating was introduced, there were 350 tubes of 1⅝ in. dia., giving a heating surface of 1,689.82 sq. ft; the firebox added 128.3 sq. ft, making the total 1,818.12 sq. ft. The grate area was 20.56 sq. ft, and the working pressure 200 p.s.i. The centre line of the boiler was 8 ft 6¼ in. from rail level.

In working order, the engine weighed 55 tons 6 cwt, of which the bogie carried 19 tons 4 cwt, the driving wheels 18 tons 10 cwt, and the trailing wheels 17 tons 12 cwt.

Superheating was introduced in 1910, and it modified the tubing of the boilers. At first, there were 84 elements, later altered to 112. With the later pattern, the tubing and heating surfaces were: 210 of 1⅝ in. dia., 1,228.02 sq. ft and 14 of 5⅛ in. dia., 215.8 sq. ft, making the total tube heating surface 1,443.82 sq. ft. The pressure remained 200 p.s.i.

Most of the engines were supplied with the standard 3,000 gallon tender with 15 ft wheelbase, though a few had the 2,500 gallon tender with a 14 ft wheelbase. The tender wheels were 4 ft 1½ in. dia. With the 3,000 gallon tender the total weight was 92 tons 1 cwt. The official tractive effort was given as 17,790 lb.

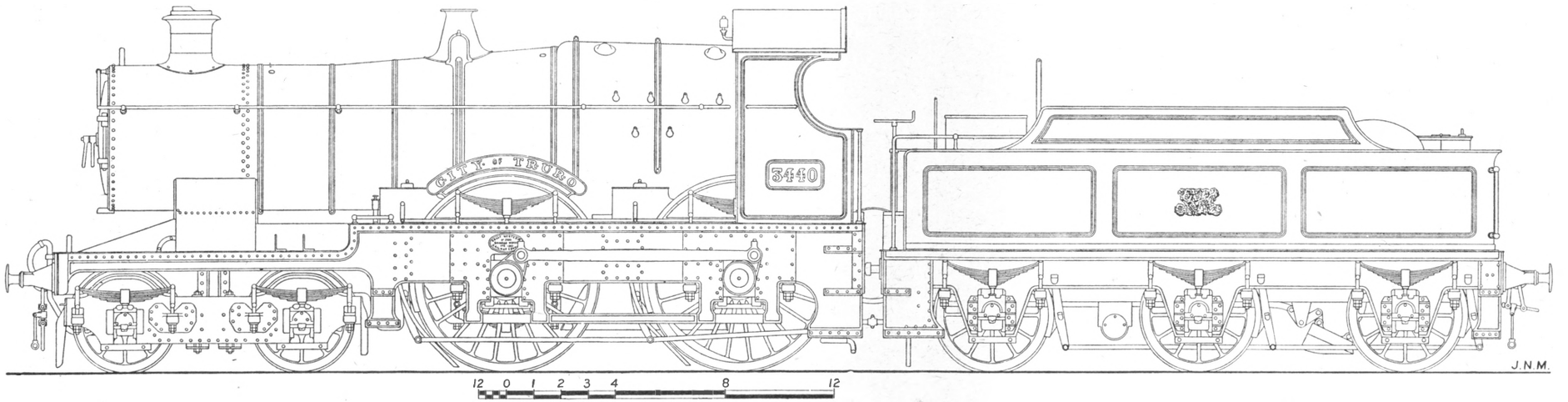
Of all the Cities, No 3440, *City of Truro* is the best known, not only for her great exploit in 1904, but also because she was one of the major exhibits in the Railway Museum at York from March 1931 until December 1956. With the dawn of 1957, this engine was also given the unique distinction of being brought out of the museum and returned to active service in the Western Region of British Railways, primarily for running enthusiasts' excursions.

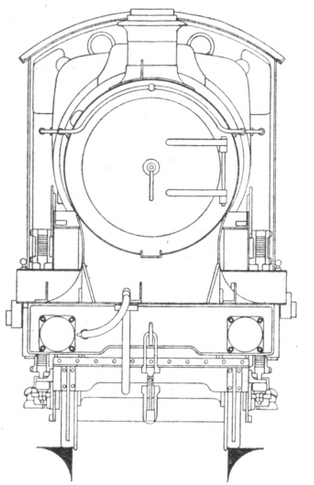
For this purpose, the engine was given a thorough overhaul at Swindon and repainted in the old GWR livery of 1903. As a result she looks very fine, though the double lining seems a little odd, even to GWR enthusiasts ; but it is right, because some engines, including one or two of the Cities, were painted in that style about 1902-1905. It did not become general, however; and that may be the reason why it is not shown on the official paint chart.

Since March 1957, *City of Truro* has run several special trips. She indulged in some high speed on occasions, the maximum, so far, being 84 m.p.h.—not too bad for a 55-year-old just fresh from a 25-year sojourn in a museum !

When not engaged on this sort of duty, she is stationed at Didcot and works a placid daily return passenger turn to Southampton and back via Newbury. I have seen her on this turn many times during the past 12 months, and must congratulate the Didcot people who are responsible for keeping her clean; they turn her out in first-class condition, as befits the heroine of *the* railway event of all time. Long may it continue !

My drawing depicts the engine as she is now, which is not quite as she was in 1904; but she is better thus than not at all. ▣





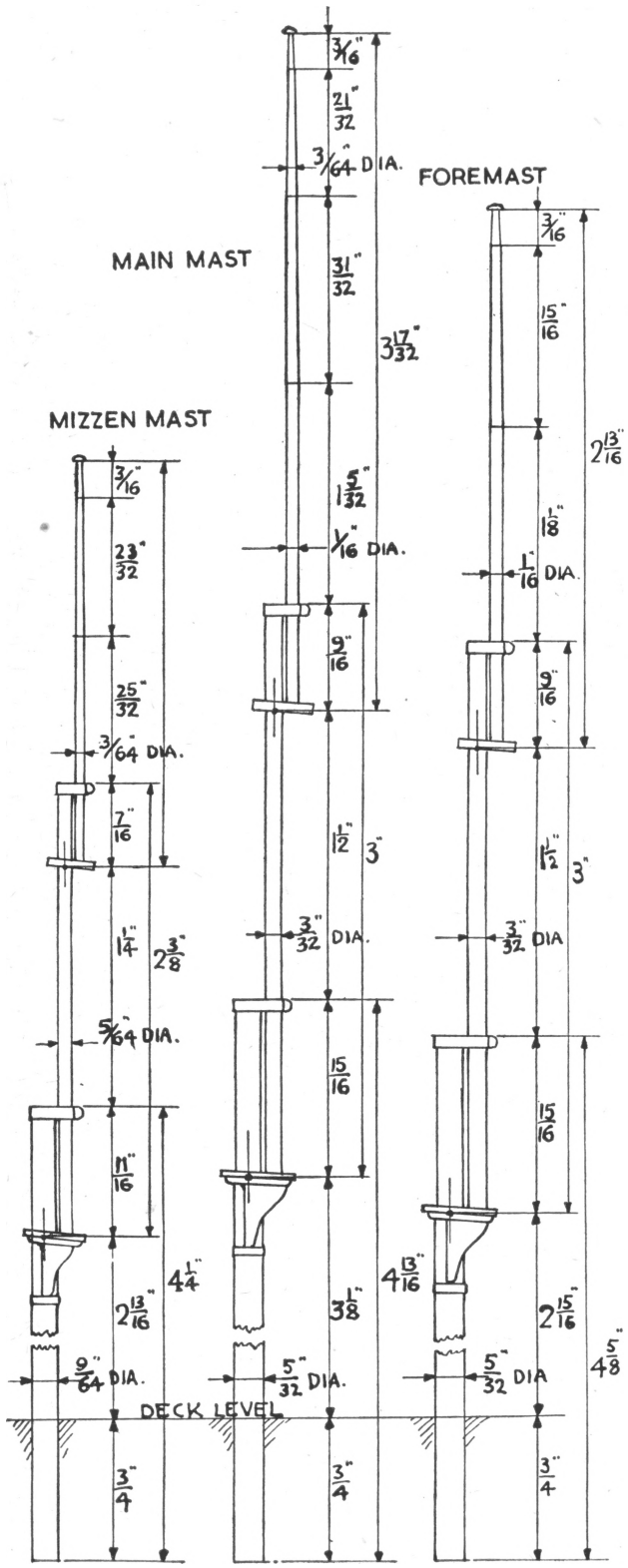


Fig. 37: The actual dimensions for the model masts

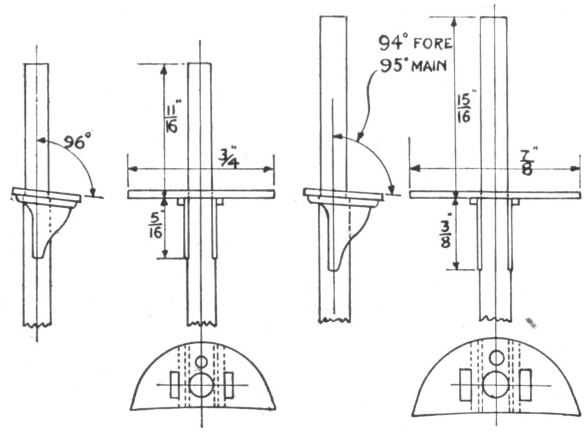


Fig. 38: Lower mastheads in detail

Rigging

Now that the hull is complete we must turn our attention to the spars and rigging. First of all come the masts. They are shown in detail in Fig. 37 with the actual dimensions for the model. These have been checked very carefully with the available data, including the page from Henderson's notebook reproduced in Frank G. G. Carr's excellent little booklet sold on the ship. They may be taken as correct. The diameters are a little overscale in the upper sections, but this is necessary for strength.

The masts are made in three sections, the lower mast, the topmast, and the topgallant mast, the last being combined with the royal and skysail mast. The lower masts, topmasts, and bowsprit could be made from wooden knitting needles if they are still available. They were made in tough hardwood, and there was a good range of diameters on sale. Plastic knitting needles are very much in vogue now, but if the wooden ones are still made they are worth looking for.

The topgallant masts, royal and skysail masts, and the jib-boom should be made from split bamboo. Bundles of sticks of split bamboo are now sold by florists shops and in the big stores. They are about 12 in. long and $\frac{1}{8}$ in. dia. and are indispensable for the ship modeller. The wood is tough and not easily broken; it takes a good finish, and can be split into the thinnest section.

For the present we will confine our attention to the lower masts. The lengths given are from the deck, and when cutting them off an extra $\frac{3}{4}$ in. should be added, as this is the depth to which the holes for the masts are drilled [see Part 3, March 20]. The curvature of the sheer line and of the deck has been taken into account in calculating these lengths.

● *Continued on page 772*

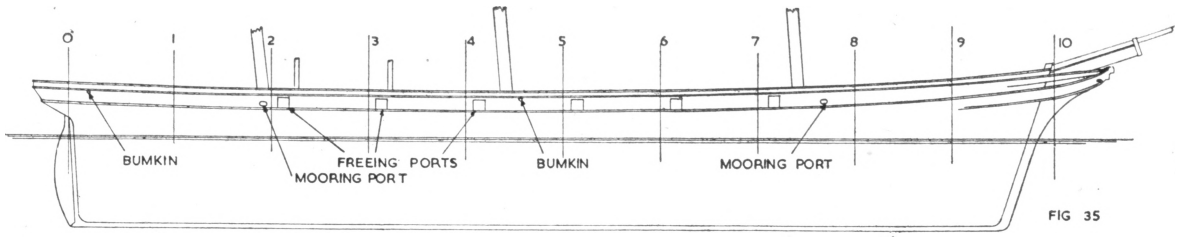


Fig. 35: *Position of the freeing ports and other external details*

by gluing on narrow strips of thin cigarette paper. These should be about 1/32 in wide and the ends should be tucked into the groove. The groove on each side should be in the form of a vee and its depth should be somewhat less than half the thickness of the sternpost.

Six freeing ports

There are six freeing ports on each side in the main deck bulwarks. They are hinged horizontally from just below the main rail so as to allow water to run off the deck in heavy weather. Their position and approximate size are shown in Fig. 35. At the small scale of our model it will be sufficient to scribe their outlines on the outside of the bulwarks, making the lines sufficiently deep to show through the painting. Two mooring ports are also shown in the same drawing. They should be drilled $\frac{1}{16}$ in. dia. and elongated horizontally with a small round file. The scupper holes for draining the waterways have been ignored in the model as they are too small.

Bumkins

The bumkins are short booms, originally known as boomkins, standing out on each side of the ship to provide anchorages for the standing ends of the braces for the yards. On the ship they are hinged so as to fold aft along the ship's side and so be out of the way when the ship is at the quay side and they are not required. Their outer ends are connected to the side of the ship by means of a short chain which prevents them hinging forward when taking the strain of the braces. They are 24 in. to 30 in. long and should be represented in the model by a pin or a short piece of wire driven in and cut off about 5/32 in. from the side. The hinge and the chain could be ignored at our small scale. There are two pairs, as will be seen in Fig. 35, one for the fore braces and the other for the main. The mizen braces are taken forward to the main mast and thence down to the deck. The after pair should be driven in the solid wood below the poop deck and the forward pair through the bulwark and into the pin rail.

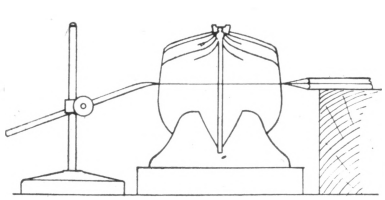


Fig. 36: *Drawing the waterline*

How she was painted

Originally *Cutty Sark* was painted black, as were most of the ships of her period. During at least part of the time she was owned by the Portuguese she had a row of painted ports below her sheer line. Her underwater body was coppered up to a few inches above her load waterline, and the upper strakes of copper would most likely be kept moderately bright. There was no line of boot-topping along her waterline except for the short time that she displayed painted ports, when she had a narrow white line along the top of the copper.

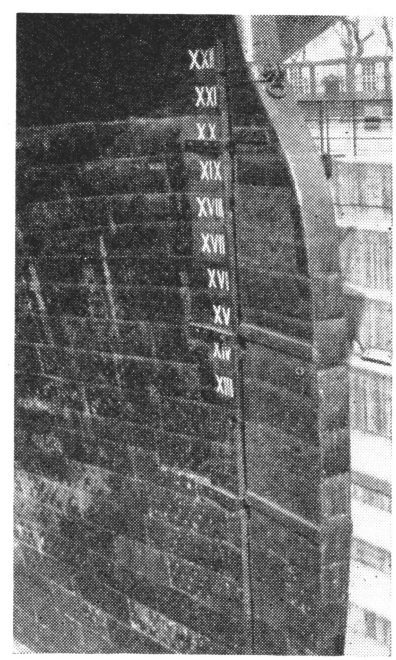
The painting of the mouldings varied from time to time. I have a photograph of her taken in Sydney harbour in 1891 which shows the main rail painted white and the sheer line dark. Another showing her alongside the quay in Sydney shows both rails black. Most photographs show the sheer line white; the main rail was occasionally white, but often not. I think the modeller would be well advised to paint her as she is now, with the sheer line white, the main rail brown or natural wood colour and the topgallant rail polished teak.

Drawing the water line

Before painting the underwater body the waterline must be drawn around the hull. To do this, put the model in its stand with the keel exactly parallel with the base. Then place the model and its stand on a reasonably flat surface—a piece of plate glass will be ideal but the top of a good table or cabinet will do, so long as there is a clear space of 12 in. or so all round the model. With an engineer's scribing block make a line all round the hull at the level indicated on the lines plan Fig. 1 [February 20] $1\frac{1}{4}$ in. above the keel. If a scribing block is not available, a substitute may be made from a block of wood of such a thickness that a pencil laid on it will have its point at the correct height (see Fig. 36). The pencil should be held firmly on the block and the line drawn by sliding the block along the flat surface all round the hull until the line is complete.

Copper for the hull

At $\frac{1}{16}$ in. scale, using shim for the copper plating on the underwater body is bound to produce an over-scale effect. The best answer is to use paint. The paint should not be a bright copper colour, as the copper goes darker and takes on a greenish tint in a very short time. Perhaps one of the metallic paints would tone down to a suitable colour, but I have not so far experimented with them. In my modelling I have used copper coloured paint, darkish in tone, and let it go at that.



The rudder and sternpost

With " Heavens light our Guide " carved between the points of a star, the stern is itself a thing of beauty

CUTTY SARK

By Edward Bowness

Continued from 29 May 1958, pages 690 to 692

HAVING finished the decoration at the bows, we next consider the scrollwork around the counter. During the restoration, the committee was fortunate in having access to the drawings of the decoration as fitted to the ship. Reproductions of the working drawings made from these were published in the September 1956 issue of *Ships and Ship Models*. They have been followed faithfully in the restoration, and as a result we have preserved for us a fine example of Victorian art.

The stern and counter of a sailing ship was in itself a thing of beauty, and the graceful design of the decoration emphasised the curves. The design was not by any means standardised, but varied from ship to ship and with the taste of the owners. That on the *Cutty Sark* is typical of the best.

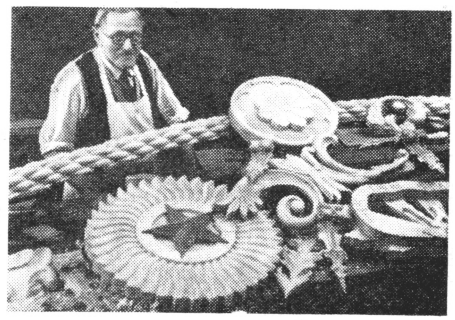
From the photograph just below it will be seen that the design is based on the arch of cable-laid rope with the star in the centre. The other photograph on this page, taken in the workshops of Messrs R. and H. Green and Silley Weir Ltd who carried out the work of restoration, shows the principal elements of the design. They were carved in yellow pine by Mr Thomas Turner, who is seen in the picture, and were fitted to a mock-up of the counter which was erected in the shops.

The central star is seen in the foreground. The words " Heavens light our Guide " are carved between the points of the star. It appears that before fitting the star in its place on the ship the ends of the radiating rays were rounded off. One of the two rosettes at the ends of the rope is shown, and also the central decoration below the star with the famous motto: " Where there is a Willis a way," a pun on the owner's name on the ribbon, and the initial " W " in the centre.

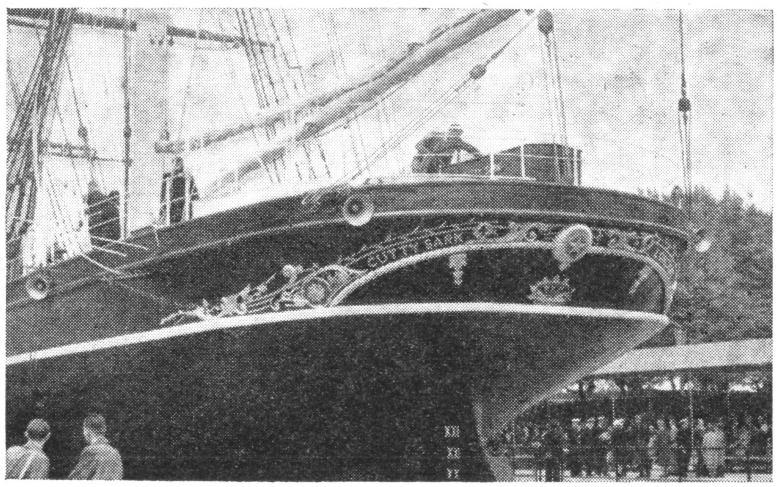
For the model the star, which is about $\frac{1}{8}$ in. dia. and could be made in plastic, should first be glued in place with the cord on each side. The rosettes which are about 3/32 in. dia. should then be cut out of card and glued at each end of the cord. The scrolls on each side of the star and those at each end of the cord should then be worked up in thread glued on, after which the panels with the name *Cutty Sark* and her port of registry, London, could be painted. The decoration below the star should be cut out of card and glued on. On the ship the entire stern decoration is richly gilded and has a very handsome appearance.

The rudder

The three circular objects which are to be seen in the photograph just above the main rail are the loud speakers which were installed to relay the Queen's speech when she opened the ship in June 1957, that being the day on which the photograph was taken. The temporary platform erected for the occasion, with its high railings, may also be seen in the picture. There are also some still taller stanchions. These were used to support the awning which was spread from over the spanker boom when the ship was in tropical ports. They need not be shown in the model as they were used only very occasionally.



Thomas Turner with his carvings in wood for the stern decoration



The entire stern decoration is richly gilded

It has been already decided that the rudder is to be made solid with the sternpost. The picture on the next page gives a general idea of the appearance of the rudder on the ship. It will be realised that the centre of the rudder stock where it enters the hull is in line with the centres of the pintles on which the rudder swings, and this must be observed when indicating the rudder by means of a groove as suggested. The groove ends just above the uppermost hinge, and above that it moves forward to show the diameter of the pintle which is probably between 15 in. and 18 in. The heel of the rudder is cut away to clear the extension of the keel which is provided to protect the rudder.

The hinge straps can be represented

Building a big boiler

continued

plate angle and firebox bottom. The throat plate is flanged on one side only, and the boiler barrel fits tightly into a 9 in. dia. hole as shown in Fig. 4.

The throat plate barrel wrapper joint

This important joint is Sifbronzed and is the first brazing operation on the boiler. The wrapper is kept in close contact with the flange via 6 BA copper stubs tapped through both parts and riveted on both sides. A unit is stood upright over three town-gas burners and brought up to a high pre-heat. The brazing medium is then rippled into the barrel and wrapper joints with oxy-acetylene equipment. Heads of the copper stubs were treated too in this fashion.

The complete inner firebox assembly with its 14 in. long box and 26 $\frac{5}{8}$ in. inside dia. copper tubes is silver soldered throughout. Care in achieving close fitting joints is amply repaid in economic use of silver solder. Total cost of Easyflo No 1 in the boiler was 50s. (Fig. 5).

Sequence of assembly is: tubes into firebox frontplate, frontplate to wrapper, then backplate to wrapper. A single gas jet suffices to act as pre-heater and an oxy-acetylene torch is used to apply local temperature. The torch flame never actually touches the silver solder, heat being applied from the side to run the solder right into the joints. Note: tubes at the firebox end were soldered from the tube end side, i.e. *inside* on the completed box. Plate and tubes were then copper stubbed into the wrapper. The barrel tubeplate is added after fitting an inner box into the barrel and wrapper.

Foundation ring

A 1 in. × $\frac{5}{8}$ in. copper bar is fabricated to form the foundation ring but while the actual ring joints are silver soldered, close screwing and soft solder caulking is the method employed to secure a sound, leak-free ring. The soft solder is added, of course, after all hard soldering has been done.

A single central palm stay helps to locate the inner box assembly while a foundation ring is being fitted. A bush for the fusible plug is silver soldered into the crown of the firebox.

After the front tubeplate has been tapped over the tubes and lined up squarely, the backhead is then added to the boiler. Fig. 6 shows in detail the method of fastening the backhead with a built up firehole door spacer sandwiched between. Great pains should be taken to have smooth, well matching surfaces between flanges and wrapper edge and no other fastening, in the form of screws or stubs, is required prior to the final silver soldering operation.

Twelve countersunk No 0 BA screws made of bronze bolt through the two backplates and spacer, and are nutted inside. The three left-hand screws are slightly longer than the others and carry the firehole door hinge bracket. All internal staying is of $\frac{5}{16}$ in. dia. copper rod threaded 32 t.p.i. Copper rod is purchased in the hard state and screwed in this condition. All stays that require riveting over are annealed before inserting into the plates.

Needs a lot of heat

Fore and aft stays, and the long cross ties, are screwed home with enlarged versions of LBSC's stay cap nuts. Inset of Fig. 6 shows how these are made up from $\frac{3}{4}$ in. hexagon bronze bar. Internal and external threads are alike, 32 t.p.i.

Bushes for the safety valves and filler cap steam dome flange are fixed to the boiler ready for the silver solder on the final heat up. This process is a repeat version of the throat plate set-up. With over a hundredweight of copper you require all the heat that's going ! Gas jets, rather like big gas pokers, are sited at strategic points about the boiler and after about ten minutes a start can be made with the blowtorch.

Front tubeplate and tube ends are run in first, and all parts fluxed, naturally. Flange faces of the end plates are best done before inserting into the boiler. The torch requires a big, diffused flame which is played around the joint from the outside. When the copper is hot enough the solder will flow. Do *not* try to run the solder by direct application of the flame. Use the torch to heat the copper only (Fig. 7).

Caulking with soft solder

Fig. 8 shows how the foundation ring is recessed to allow $\frac{1}{4}$ in. thick layer of soft solder to be run in. Soft solder caulking is done at leisure using a five and two pint paraffin blowlamps. Not all stay heads will need treating, some will respond to extra snap head hammering.

A regulator is housed within an 18 in. long, $1\frac{1}{2}$ in. dia. copper tube (Fig. 9). The complete unit is easily removable through a large hole in the front tubeplate. Steam is picked up beneath the dome and passes through holes in the rotating port and transferred, when the regulator handle is turned via the steam take-off block to the superheater wet header.

Twelve hairpin elements, six on either side of the petticoat pipe, lead steam to the bottom header drum and from there to the cylinders. The steam pipe connections to the headers are made by sawing off the end portions of $\frac{1}{2}$ in. solderless pipe fittings and silver soldering the pieces to the drums direct. An extremely neat fitting results occupying little space.

The five pint blowlamp supplies the necessary therms for an all silver solder job. Every brazed or silver soldered joint on the boiler is well scrubbed with kit brush and hot soapy water. It is too big an object to pickle completely ! No trouble is experienced with priming, even on the first steam up.

Annual hydraulic tests of 180 p.s.i. (steam tests 120 p.s.i.) are carried out for insurance purposes and, so far, have satisfied all concerned.

The total cost of construction was about £50 of which £10 was paid to the welding expert for his gas, time and, not least, skill.

No form of flame deflector (brick arch) has been fitted and the tubes seem none the worse for it. Considering the vast amount of heat necessary to put the boiler together I feel the engine's own fire would never be hot enough to do serious damage. ▣

Things to come

EVERY modelling exhibition that one visits, every live steam club track in the English-speaking world bears witness to the work of LBSC. Precisely when did he describe a particular engine ? As this question is often asked by old readers and new the list in ME of June 19 will be much consulted as a guide. The feature covers the classic engines described in the whole LBSC series.

Live steamers who are spending their holidays in the English dales will enjoy W. Hubert Foster's article on the Ravenglass and Eskdale Railway; so will those who are spending their holidays elsewhere.

J. H. Benson, secretary of the MPBA, describes a 15 c.c. four-stroke engine suitable for power boat propulsion.

Boys who have discovered the adventure of model building are being well catered for by a new club devoted to their interests. R. W. Tandy tells of this venture next week.

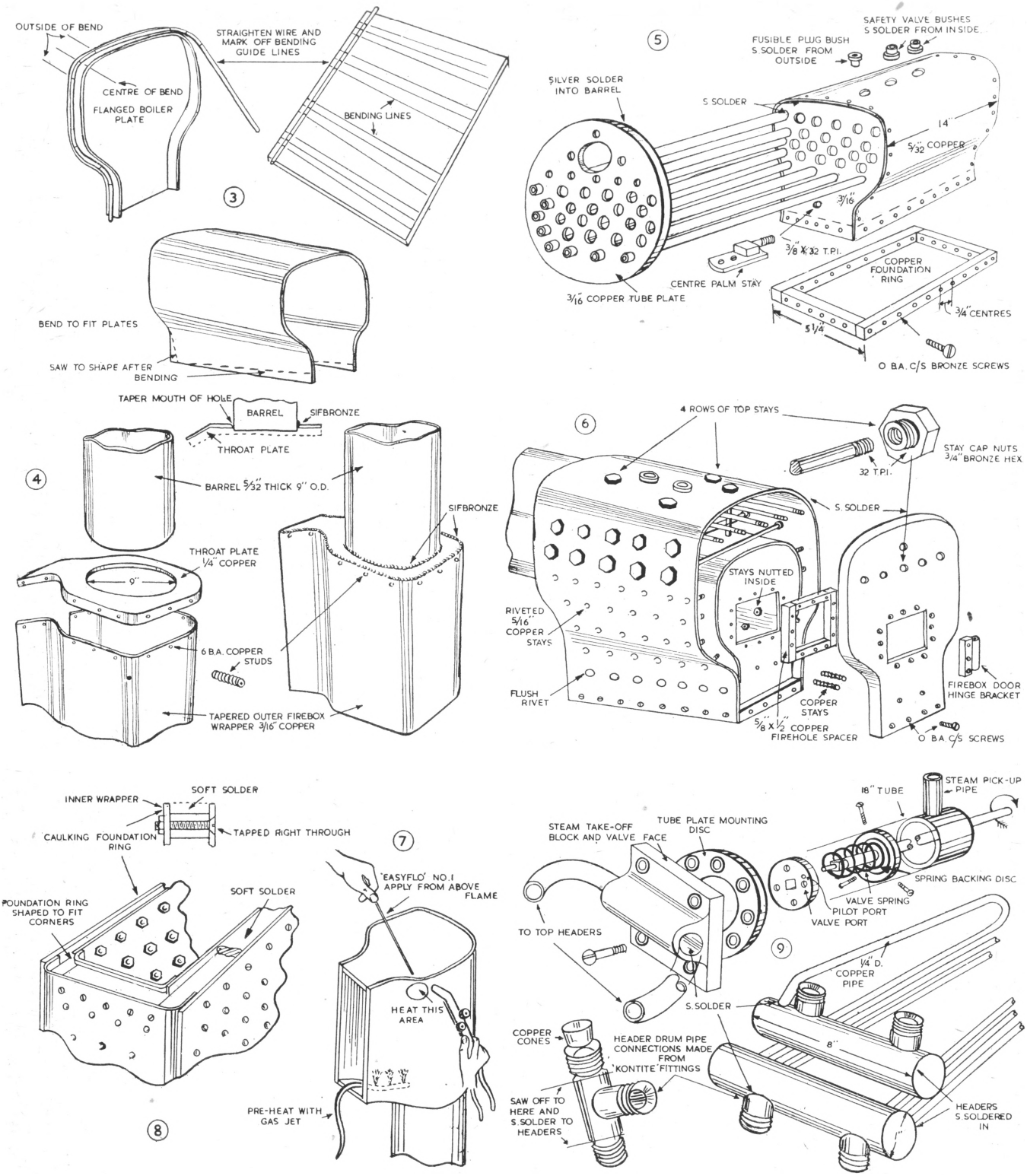


Fig. 3: Marking and bending the wrapper. Fig. 4: Throat plate/barrel wrapper joint. Fig. 5: Making the inner firebox wrapper and fixing tubes. Fig. 6: Assembling the backhead and staying the boiler. Figs 7 and 8: Silver soldering and caulking methods; caulk stay heads and nuts with soft solder after water test. Fig. 9: Smokebox grid-type steam heater

Building a big boiler

Though an expert stage conjurer, ERIC HAWKESWORTH demonstrates some different tricks for the live steam enthusiast

THE construction of copper boilers for large scale locomotives is always a controversial talking point whenever model engineers discuss the subject. Should such boilers be of all riveted and caulked construction, or is it possible to braze such a large mass of copper without it costing a king's ransom? If brazing *is* carried out, is it necessary to flange boiler endplates?

If a model maker does embark on a boiler building project for, say, a 7¼ in. gauge engine, how much work can be achieved in a small home workshop without calling on outside professional aid? Do you need a brick arch to protect the tube ends in the firebox? These questions, and a score of others, have been put to me by interested persons during the last four operational seasons of public passenger hauling with my own 1½ in. scale *Royal Scot*.

During this article I will endeavour to explain how, using a set of Henry Greenly's drawings, the *Scot* boiler was bent up and assembled in average home workshop surroundings. Main boiler joints were Sifbronzed and silver soldered by a local craftsman using gas pre-heating jets and an oxy-acetylene torch. All his heating set-ups will be explained and I will give an assessment of gas, materials and labour costs.

Big copper boilers are expensive but, considering time to construct is little more than that taken for a 3½ or 5 in. gauge job, the cost margin isn't really so great—and you do have something to show for your labours!

I don't claim my building methods and solutions to be the last word or, indeed, the only way of doing things. Everything mentioned, however, is practical and has proved itself in actual operation.

The smokebox grid-type superheater has come in for more than its just share of criticism and experiments running with, and without, the device prove that it does provide a moderate degree of superheat. Without the grid, the engine still pulls its loads but coal consumption goes up and the exhaust is much wetter, with plenty of visible steam even on a warm day.

A solid bending rig

Inner and outer firebox wrappers were bent on the rig illustrated in Fig. 1. Two mild steel angle irons of 1½ in. by ¼ in. section measuring 3 ft long are gripped in the bench vice at one end, and are supported by a hardwood block bolted to the bench at the other. A large G-clamp closes the angles on the work at the block end. By reversing the outboard angle and inserting a 3 ft length of 1½ in. dia. steel pipe. angles can be neatly rounded in the wrappers. Both my wrappers were bent on a similar rig using nothing more drastic than arm pressure and wooden mallets.

Formers for the boiler end plates were of cast iron and were run by a small local foundry from simple wooden patterns of my own making. Allowance must be made for a slight shrinkage of the casting, and the patterns need to have a good draw with a well rounded bottom edge. Finished castings should be at least 1 in. thick (Fig. 2).

Copper sheet for the end plates and wrappers should be bought in a soft, annealed state and it costs no extra but makes the job much easier. Plate $\frac{3}{16}$ in. thick can be patiently manipulated over the bending rig.

After the firebox end plates have been flanged over the formers, soft copper wire is bent to follow the flange contour and it is then nicked to locate the centres and extremities of the corner bends (Fig. 3). Wires are then straightened and laid out on the wrapper sheets. Using the file nicks as guides, bending lines are lightly scribed across the sheets. These indicate the start, centre and finish of each bend and enable you to form the wrappers pretty accurately.

The throat plate slope back and foundation ring contours can be produced after the wrapper is bent up. Simply saw the unwanted portions away after marking out the throat

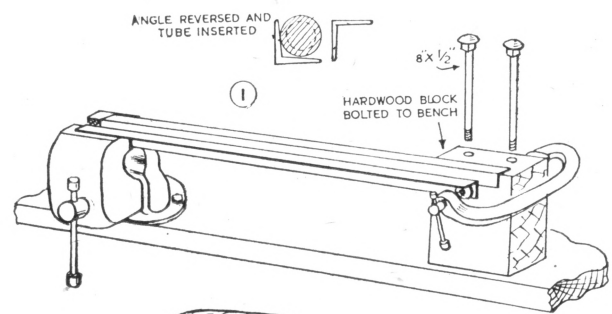


Fig. 1: A solid bending rig

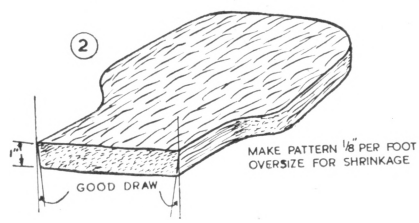


Fig. 2: Cast iron formers

Checking accuracy of gears

WORKSHOP HINTS and TIPS

By GEOMETER

USING very simple workshop equipment, virtually without calculation, it is possible to establish whether spur gearing in its main dimensions and detail features, attains the expected precision and uniformity—and if not, where the errors occur. This can be particularly important for new gearing; while that which has been in use, can reveal, by comparision with the new, or by comparision of worn teeth with good ones—when wear has been irregular, just to what extent this has progressed, and resulted in noise and backlash.

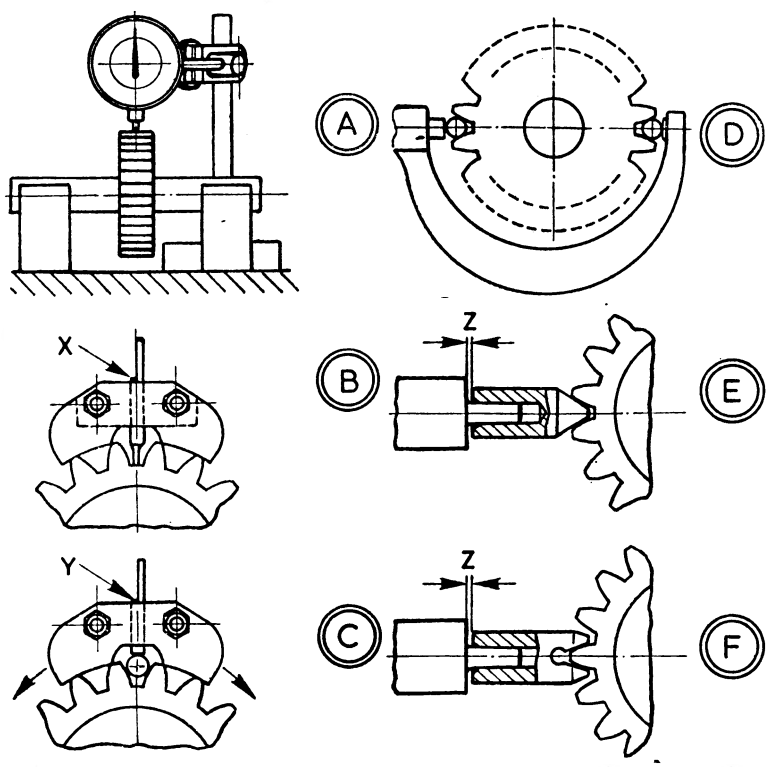
Noticeable variations in thickness and spacing of teeth occasion backlash and errors of pitch leading to whining in gears under load; and in applications where a few teeth only are subject to load, and wear more than the others, as in operating a cam, there inevitably arises a rhythmic clatter.

Checking concentricity of tips of gear teeth about the axis can be done on a surface plate, mounting the gear on a mandrel, and placing this in V-blocks, as at *A*. The most accurate test is made with a dial indicator on the surface gauge; but a reasonable one can be made with a scriber pointer, followed by a close scrutiny if suspicions are aroused.

With the same set-up, but using a roller in the teeth to make contact approximately at the pitch circle, the important condition can be established of the concentricity of this circle about the axis, the roller being changed from space to space and passed under the indicator. A gradual change in indicator reading, with extreme readings on opposite sides of the gear, would indicate an over all eccentricity, with the teeth cut, or generated about another axis.

Substantial variations in readings with the roller in closely adjacent teeth would indicate local wear in a used gear, or errors in tooth thickness or pitch in a generated gear. In a cut gear (one whose teeth have been shaped or formed with a slotting type cutter), errors of tooth thickness and pitch could exist without discovery by this test, as they would lie in the teeth, with all the spaces the same width.

With a gear tested for concentricity over the tips of its teeth, uniformity of their depth can be checked with a simple depth gauge, as at *B*. The body of this can be part of a thick ring bored to the outside diameter of the gear, or can consist of a block bolted between two plates cut from a thin bored ring. A drilled hole accepts a pin which can be filed half through on the top side, either with a small shoulder or flush at X, to function like a flush pin gauge. Then, with a roller in the gear teeth, as at *C*, such a gauge can be used for checking concentricity of the pitch circle, and uniformity of space width, a shoulder on the pin at Y.



Simple test

A large micrometer or gap gauge with an adjustable anvil can be used with rollers, as at *D*, in a simple test checking for wear on teeth or variations in space width. Eccentricity of the pitch circle would not be revealed, however, and neither would variations in tooth thickness where there is uniformity in space width.

For comprehensive checking, a lathe is as good as anything, the gear being mounted on a mandrel held one end in the chuck, the other supported by the tailstock centre.

Rotating the gear on the mandrel, an indicator or pointer will prove concentricity of the tooth tips; and using on the slide rest a holder with a turned down end, and on this a sleeve with a pointed nose, as at *E*, uniformity of space width can be checked by consistent clearance at *Z*—verifying with feeler gauges. The cross slide should not be moved, of course, the gear being slid on the mandrel or the saddle on the bed to change spaces. With a V-jaw sleeve, as at *F*, tooth thickness can be checked; and the two tests together prove accuracy or otherwise in tooth indexing. ▣

engine taking a left-hand or right-hand turn, or if one of the wheels runs on to soft ground, then conditions in the transmission change.

Hence, with the slowing down of, say, the left-hand driver, the corresponding left-hand bevel wheel will also run slower otherwise there will be no change of speed in the remainder of the differential drive to the right-hand wheel save that of a small bevel pinion which now begins to function as such.

The conditions are such, therefore, that the two bevel wheels, although turning in the same direction, are running at different speeds to each other, and as a consequence the small bevel pinion must also rotate on its own axis as well as turn about that of the large 75 t spur gear. It will be seen, that the bevel pinion is sensitive to any change in the relative speeds of the two drivers and will rotate on its own axle one way or the other.

Unless the model maker possesses the requisite tools for cutting the gear teeth it would be advisable for him to have the wheels and pinions made by a firm of gear specialists. Providing details of the tooth profile are supplied, machined gear blanks are usually accepted for gear cutting. With this idea in view details for machining three bevels are shown in the diagram on this page (Fig. 8).

In the generating process of cutting bevel teeth the tool is made to represent the tooth form of the pinion and has straight sides. In operation, therefore, the cutter is made to simulate the pinion or the wheel, as the case may be, until the gears are completed.

The two bevel wheels are turned from 1¾ in. bright, round mild steel stock, care being taken to taper the top bevels accurately to the angles shown. Each wheel has 30 t so that the subtended angle from the centre is 12 deg. Both wheels are bored to suit the main axle, one a good driving fit and the other a free running fit on the shaft. The latter can be made with a fitted bronze bush to run on the shaft if desired. Note also that the inner 30 t wheel is to be keyed to the shaft so that a keyway of ⅛ in. wide × 1/16 in. deep is cut into the boss.

The bevel pinion, Fig. 6, has 10 t, and is machined out of ¾ in. round mild steel stock bar and made a free running fit on its spindle. Referring to Fig. 1 it will be seen that the pinion is mounted on a bracket which is screwed to the main 75 t gear and a slot is cut for the purpose of providing a working space for the pinion. The bracket is a simple item made out of a piece of ⅜ in. × ⅝ in. bright mild steel flat bar (Fig. 7). I have arranged the bracket so that the pinion centres midway between the bevel wheels.

The bronze or steel collar fits over the main axle to separate the two bevels and is 11/16 in. dia. × 11/32 in. wide. The large 75 t gear must be made to run freely on this collar.

Strictly speaking, the bevel pinion attachment throws the large gear out of balance, but this is countered to some extent by the projecting boss diametrically opposite. I have shown this boss as a separate item bolted to the gear wheel. It is drilled to receive a 3/16 in. locking pin.

In full-size practice the right-hand bevel wheel fits over, and is secured to, the hub of the road wheel. The transmission is, therefore, taken direct through the bevel wheel only. For the 1 in. scale model I have shown the pin locking both the road wheel flange, and the bevel gear as detailed in Fig. 5, but for a model in one of the larger scales, an exact replica of full-size practice is to be recommended.

● *To be continued*

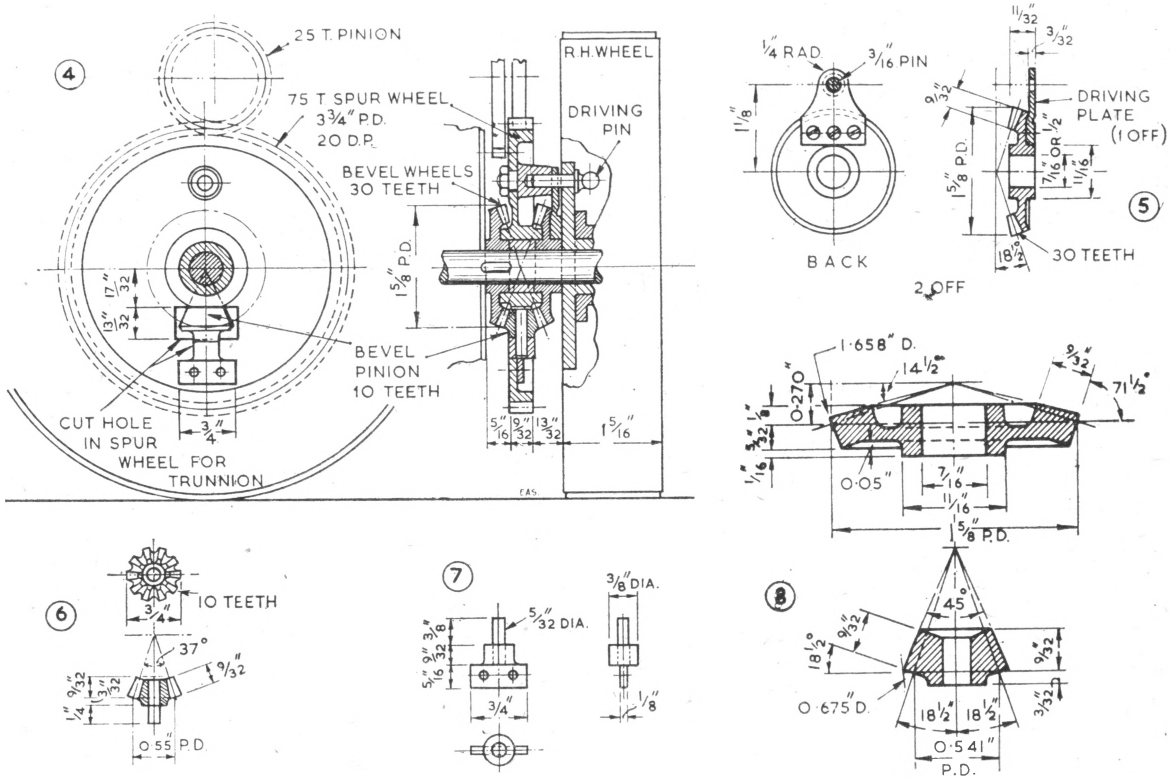
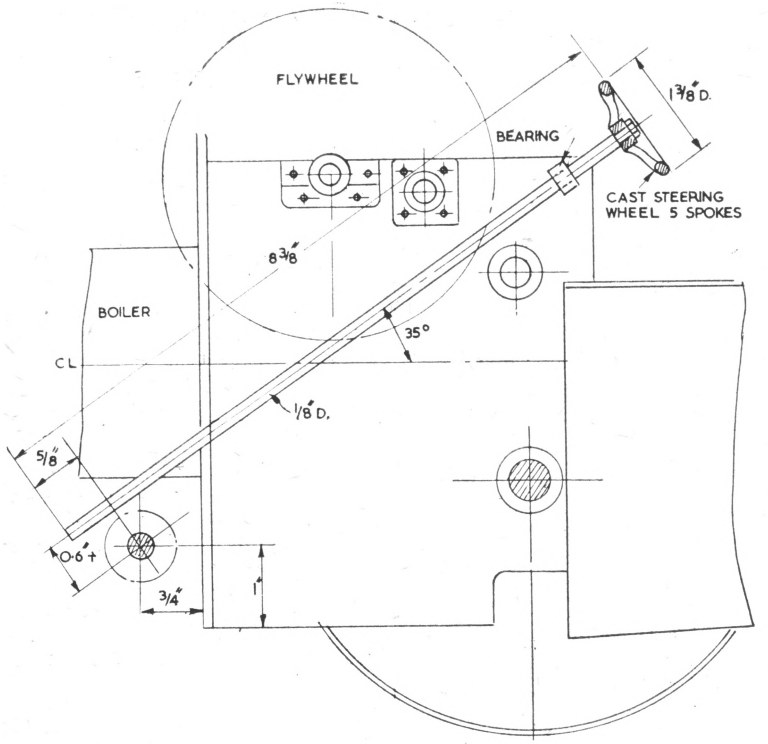
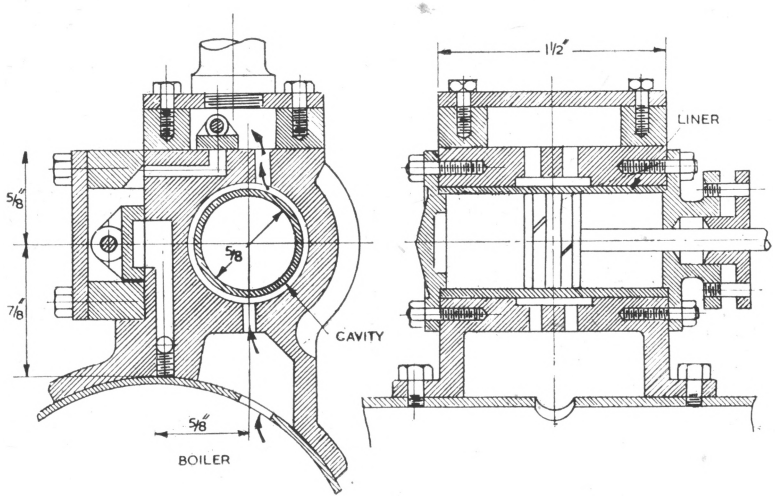
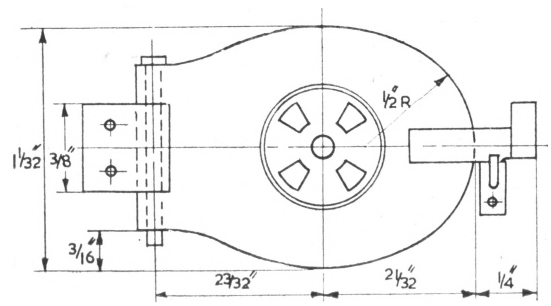


Fig. 4: Differential gear for traction engine; Fig. 5: Bevel wheel; Fig. 6: Bevel pinion; Fig. 7: Bracket for pinion; Fig. 8: Bevel gear blanks







Top, Fig. 1: *Setting out of steering column*; *Centre, Fig.* 2: *Steam jacketed cylinder*; *Bottom, Fig.* 3: *Davey Paxman type of firedoor*

out on the drawing board. In fact, the design follows very closely that of a full-size machine.

The gear functions in a manner similar to that of the rear axle of a car, but where it may be lacking in refinement and precision of the modern high speed vehicle it can be said to gain in robustness and a solidity of construction !

On examination of the drawing, Fig. 4, it may not be immediately apparent how the gear works as there are various removable driving pins and keyed ways forming part of the assembly which contribute to the transmission of motion to the pair of driving wheels. At the outset, therefore, it must be made clear that both driving road wheels must be free on the axle and should not be keyed directly to it under any circumstances. The explanation is quite simple: when the traction engine is stationary and the winding drum is in use, the main axle only is driven, the hubs of the two wheels merely acting as a pair of plain bearings. For the purpose of demonstrating the differential gear, however, it is assumed the vehicle is in motion and that all driving pins are in position.

How it works

The 25 t pinion as shown drives the 75 t spur wheel and so far it will be seen that the drive is no different from that of the more simplified drives already discussed. With the driving pin in position, not only is motion transmitted direct to the right-hand road wheel, but is conveyed to the right-hand bevel wheel of the differential gear. This bevel wheel is free on the axle and it should be noted that the large 75 t wheel is also free on its bearing collar. A driving plate (Fig. 5) couples the 75 t wheel to the right-hand bevel wheel.

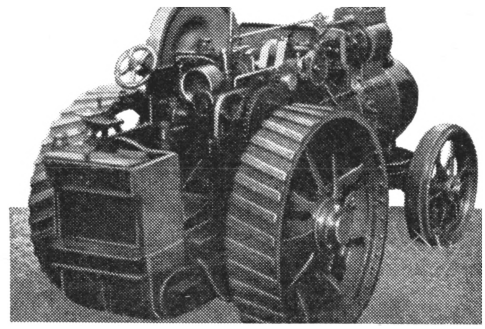
Further transmission can only take place through the small bevel pinion mounted radially on the 75 t gear wheel and by this means the left-hand bevel wheel is rotated. This gear is keyed to the axle and therefore transmits motion to the left-hand driving wheel.

With both driving wheels turning at the same speed (and in the same direction, forward) the small bevel pinion, although it is rotating bodily with the main spur gear wheel, does not turn about its own axis. Power is simply transmitted from the large wheel to the left-hand keyed bevel wheel through the teeth of the pinion. In this the right-hand bevel wheel also plays its part in preventing the bevel pinion from rotating on its own axis.

Immediately there is a change in the speed of one or other of the driving wheels due to the traction

The MODEL ENGINEER

TRACTION ENGINE



After clearing up some of the mysteries of the steering ERNEST A. STEEL presses on with details of a differential gear design

Continued from 29 May 1958, pages 701 to 703

THE steering column shown in Fig. 1 is inclined 35 deg. and is located between the flywheel and hornplate. In the setting out take care to see that the steering shaft clears the top of the third driving shaft bearing. There is only a little space here for the shaft so it may be necessary to remove the corner of the bearing flange. The lay of the shaft, however, will depend upon the assembly of the worm gear casting. A small supporting bearing for the steering shaft is fixed to the top corner of the hornplate.

The cast handwheel need only be bored $\frac{1}{8}$ in. and the boss faced and cleaned up with a file. A hole is drilled and tapped 8 BA in the rim for the turned and polished handle or it may be simply riveted in position. The inclined steering column is selected from a straight length of $\frac{1}{8}$ in. or 5/32 in. bright mild steel, or silver steel rod $8\frac{1}{2}$ in. long.

A pair of chains, which are measured off to length on assembly, encircle the spud pan and almost meet at the front where they are secured to rings and shackles, the latter being secured to the rim with screws.

Steam-jacketed cylinder

Since writing this article I have found that the wormgear ratio of the Fowler 6 h.p. traction engine of 1906 was 15 to 1. The wormwheel had 30 teeth, but the worm had a two-start thread. A contemporary photograph shows crossed steering chains. Incidentally, in many cases the steering column is located on the right-hand side of the traction engine.

There is one aspect of the cylinder design I have not yet considered in detail, and that is the arrangement with separate liner and steam jacket. I was reminded of this by reference to a copy of the ME dating back to 1933. There, I found a cross-sectional drawing which is reproduced here (Fig. 2). The cylinder is bored oversize to admit the liner and is then bored out 1/32 in. deep to provide the steam jacket. Passages are drilled top and bottom for steam to encircle the jacket en route from boiler to regulator valve.

No doubt, this arrangement will be preferred rather than the drilling of long passages at awkward angles through the side of the casting, but care will have to be taken in boring the jacket space to ensure that no break through occurs into the adjacent steam passages above, which lead to the slide valve chest, or vice versa. Neither must the exhaust steam passage below be overlooked. Under these circumstances, it would be as well for the actual cylinder bore not to exceed $\frac{5}{8}$ in. By making the outside diameter of the liner 23/32 in., the jacket in the main casting need only be enlarged to 25/32 in., or just over $\frac{3}{4}$ in. if there is any risk of thinning the dividing walls too much. It should also be a good interference fit and steamtight $\frac{5}{16}$ in. each end.

Looking back I find that in referring to various drawings, a number of those inevitable errors and omissions have revealed themselves. Thus it is quite evident that the driving wheel was 6 in. dia. as specified, but that important dimension was overlooked on the original. A number of instances can be cited where 40 t.p.i. is specified for $\frac{5}{16}$ in. and $\frac{3}{8}$ in. studs and bolts, whereas 32 threads is the correct number for the ME standard of Whitworth form. By comparison the BSF thread is coarser with 22 and 20 t.p.i. respectively. Again, the BA thread can be substituted where possible for all sizes below $\frac{1}{4}$ in.

I have already indicated minor corrections and modifications to the cylinder block in a recent article, but nothing that would involve alterations to patterns. The same applies to the setting out of the gears on the crankshaft and No 2 shaft. On the original drawing the two driving pinions on the crankshaft could be spaced a little wider apart to ensure that the pair on No 2 can be freely disengaged from one or the other.

In drawing attention to the possibility of errors occurring, I can but quote H. Greenly: "In designing a locomotive or any complicated machine, you have to consider so many other parts other than those being dealt with, I should like to hear of any errors in dimensions that occur so that they may be corrected."

As an appendix to this article I have included a detail of the fire door similar in design to that of the Davey Paxman 6 h.p. traction engine. Providing there is enough space for it between hornplates and that it can be swung clear of the driving axle on so small a working model, then this type of door is to be preferred if only from the point of view of general appearance and accuracy, but it may be found that the opening is somewhat restricted when firing solid fuel.

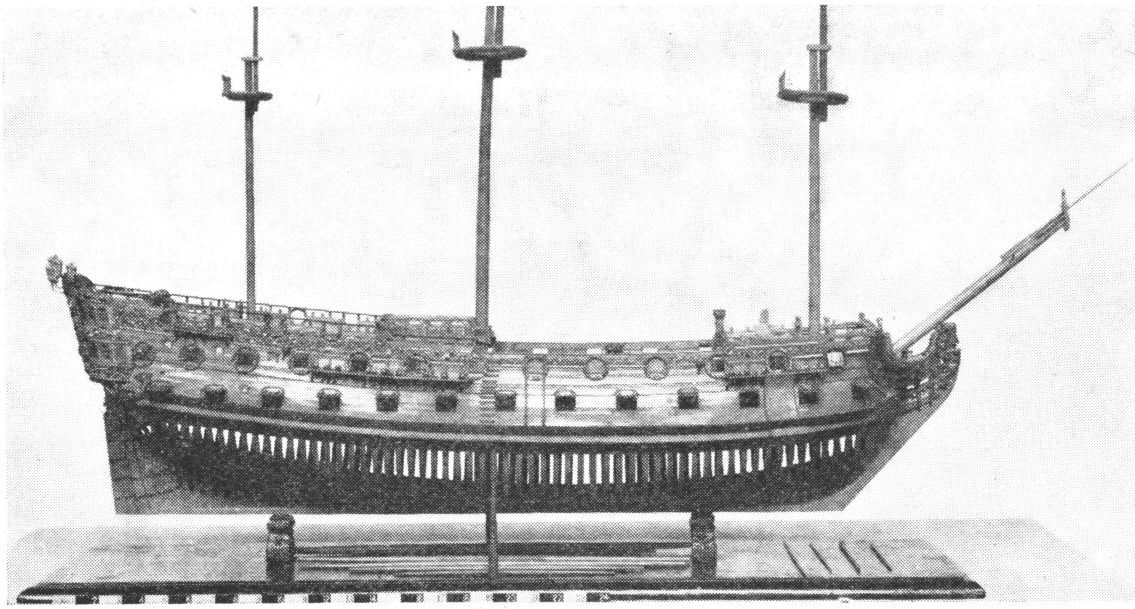
More like full size

While the simple spur gear and pinion arrangement between the third shaft and driving axle will serve the purpose for most model engineers, there may be others who have a preference for reproducing the correct type of drive and one that is more representative of full-size practice.

I had given the matter some thought, and it remained for me to prepare the details. Fortunately, I have particulars of the Davey Paxman differential drive from which it was possible to prepare working drawings suitable for the model. Having had experience in the design of geared drives for industrial machines, I readily agree that considerable care and skill is demanded in the making and assembly of the gear unit.

In Fig. 4 I have shown the complete assembly as it is fitted between the hornplates and right-hand driving wheel.

In scaling down full-size mechanisms to suit a working model it is usually necessary to make minor adjustments and perhaps modifications to details that would otherwise not prove satisfactory. I was, therefore, agreeably surprised to find that in setting out the differential gear there was but little alteration to carry



the property of Richard Hampden, Treasurer of the Navy in 1718. From him, together with the 70 gun HMS *Edinburgh* of 1721, it descended to the Earl of Buckinghamshire.

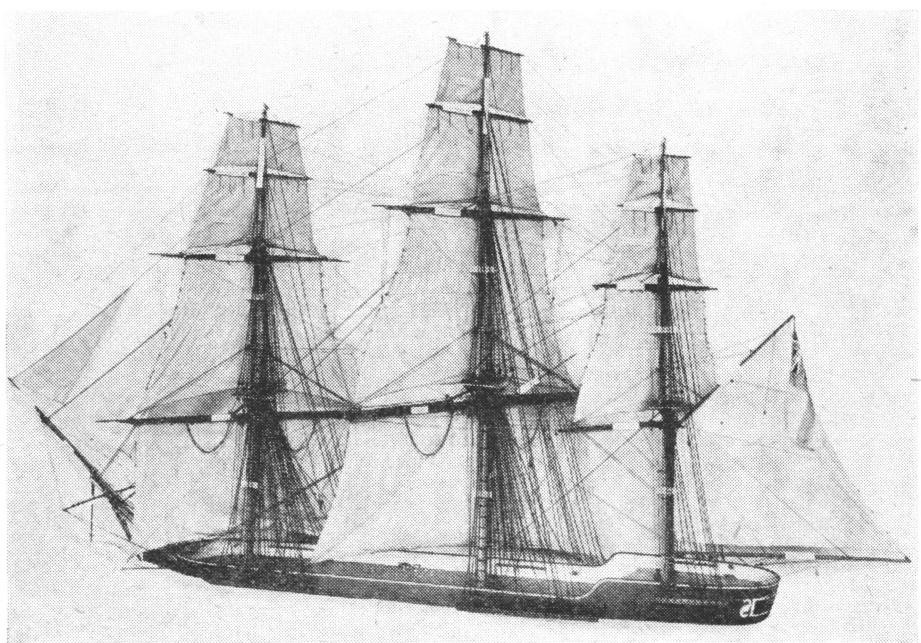
The HMS *Boyne* model of 1790 bequeathed by Algernon Brent marks the end of an era in ship modelling. When war began with France in 1793 the royal dockyards and the private shipbuilders were too busy to make any models, and the coming of peace in 1815 failed to bring back the old methods. After Waterloo the models were much simpler.

This does not mean that ship modelling stopped entirely in the war years. On the contrary, something very interesting indeed happened: a new school of modelling grew up among the prisoners of war in England when the dockyards, which were normally the centre of the craft, confined themselves almost entirely to half-block models.

In America during the war of 1812 English prisoners re-rigged a damaged model of Old Ironsides and made the work a great success. Similarly, the prisoners at Dartmoor, Porchester Castle and Norman Cross were capable of beautiful craftsmanship as we can see from the models in the Museum. But they were making their models for sale and this need sometimes led them to add all kinds of bits and pieces and to choose the most marketable name !

Modelling continued. But the models of the future would not only be simpler; they would be different in many other ways, for the ships which they reflected were themselves entering an era of change, the greatest in their immemorial history. The hero of Trafalgar, alone among the naval leaders of his time, had spoken with enthusiasm of steam; and two years after his death Robert Fulton in America built the *Clermont*. At sea as on land, the new age was beginning. ▣

Top: *A 60 gun ship of 1691*



Right: *HMS* GANGES *(port broadside)*

he, too, who worked out the rigging, an experience which led him to write a book which is much valued in Britain and the USA (*Seventeenth Century Rigging* published by Percival Marshall).

To another distinguished shiplover, Dr C. Nepean Longridge, we are indebted for a famous rigged model of HMS *Victory*. Dr Longridge built her (to 1 : 48 scale), rigged her, and bequeathed her to the Museum. Although she differs from the *Prince* in being a modern reconstruction, she can be accepted as a correct picture of the *Victory* on the day that Nelson fell.

Six years, six figures

Besides studying the full-size ship at Portsmouth, Dr Longridge worked from copies of the original plans used by the Admiralty in reconstructing her. No ship lives for ever. If Old Ironsides at Boston is not the original frigate that put to sea 180 years ago, neither is Nelson's flagship at Portsmouth the vessel which was built at Chatham to Sir Thomas Slade's design between 1759 and 1765. The restoration of HMS *Victory*, a work which occupied six years and cost £100,000, was the last of several renovations and rebuildings.

After two middling repairs from 1783 and 1792 the ship was rebuilt between 1800 and 1803, the open stern with its two galleries being replaced by the closed stern. This was the *Victory* of Trafalgar, the *Victory* which we see at Portsmouth and in Dr Longridge's beautiful model. Another rebuilding, begun the year before Waterloo, the second year of her retirement from ocean-going service, saw the old square bulkhead removed and replaced by a built up round bow.

Sometimes the Ships Gallery acquires a model, such as the *Prince* of 1670, whose identity is unknown or uncertain. Every possible clue is then considered. As the first and obvious step, the dimensions indicated by the model are compared with the known dimensions of a full-scale ship which it might conceivably represent. However closely these measurements agree, he would be a poor detective who demanded nothing more. All sorts of factors are taken into account and not infrequently the evidence of the dimensions is contradicted by something else.

As an example we have the model at 1 : 60 scale of a first rate belonging to the period 1714-1726 when George I was King. While the principal dimensions correspond very closely with those of the *Royal George*, built at Woolwich by J. C. Acworth in 1715, a comparison with the original Admiralty sheer draughts shows so many differences in detail that the identification remains indefinite. To increase the doubt, both the main and subsidiary dimensions of the model conform quite well with those of a 100 gun ship on the 1719 Establishment. Consequently the model may represent, not the *Royal George*, but a project which for some reason failed to mature.

There are many puzzles of this kind. Is the sloop of war, rigged as a snow and similar to the *Tryal* sloop which accompanied Anson as far as Juan Fernandez, the Woolwich-built *Happy* of 1711 ? Can the rigged 60 gun model lent by the Earl of Buckinghamshire be the *Dunkirk*, launched in 1704, or the *Dreadnought*, launched in 1705, both built by William Johnson at Blackwall ? And this 80 gun ship might be the *Cornwall* of 1726, the first of her class—but is she ?

As in the art world, the process of detection works both ways. Thus, while the *Achilles* model has been named with confidence, a 32 gun frigate of about the same year is no longer accepted as the *Cleopatra* of 1779. Dimensions are reasonably close, but no 32 gun frigate of that period, say the experts, was built with the square beakhead bulkhead to be seen on the model. Instead, the evidence of the figurehead, a goddess with peacocks at her feet, suggests the *Juno* built in the Thames in 1757.

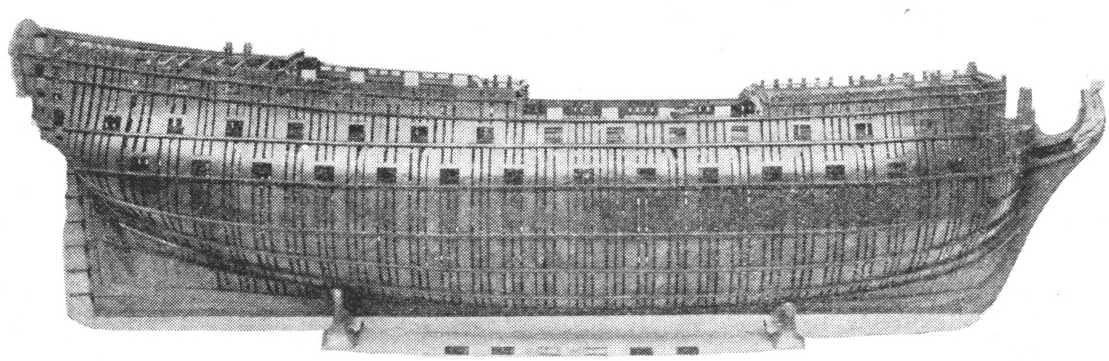
Experience shows that the source of a model is by no means a guarantee of the identity attached to it when it arrives in the Museum. The alleged *Cleopatra* once belonged to T. J. Ditchburn, a well known naval architect who lived from 1801 to 1870. Similarly, Admiral T. Pickering Thompson had a model which was taken to represent HMS *Fly* commanded by his father, Admiral John Thompson, in 1806, but a comparison reveals that *Fly* was narrower in the beam and longer in the quarterdeck; and so the model is listed without a name as a 14 gun sloop of war of about 1770.

Some of the models have interesting histories. The longitudinal section of a 60 gun ship, possibly Spanish, of about 1750 was saved by a British naval officer when the British and French destroyed the dockyard at Sevastopol. It had been used on the dockyard as an instructional model and from all the horror of battle and cholera it was brought safely to England.

Masefield's ship

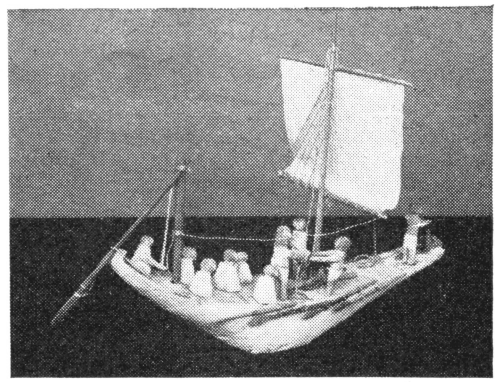
Among the royal models we find a French 80 gun ship of the same class as the *Canopus*, taken by Nelson in 1798. This model was lent by King George V after having passed to him from the late Duke of Edinburgh, and on the evidence of its Russian ensign with its blue saltire of St Andrew, it may have belonged to the Duchess, whose father was the Czar Alexander II. Another model from George V is the training ship *Conway*, of which we can read at first-hand in John Masefield's *New Chum*; it was made on board *Conway* and presented to the King in 1932.

Here and there we come upon a model which has been handed down as a family possession over a great number of years. The early Queen Anne ship which could be the *Dunkirk* or the *Dreadnought* was at one time



HMS BELLONA. 74 *guns* (1760) *in frame*

A cradle of ship modelling



Model of Egyptian boat (about 2000 BC)

JOSEPH MARTIN, at the Science Museum, reviews the long line of marine modelling

FOUR thousand years ago, when Ur and Babylon were splendid cities, when Assyria was rising, when the Phoenicians entrusted their sails to the farthest known shores—four thousand years ago, or near it, someone in Egypt fashioned a model of a ship.

I was looking at it this morning.

Of all the models in the Science Museum at South Kensington, this little craft with its charming figures is, I believe, the oldest. We owe its survival, as we owe the survival of so much else, to the burial customs of antiquity. In Ancient Egypt, particularly during the XIth, XIIth and XVIIIth dynasties, it was common for models of boats to be placed in the tombs of kings and nobles. The funerary use of full-size craft was, of course, widespread and we have a famous example of it in the treasure ship at Sutton Hoo. But here, in the Egypt corresponding more or less with the times of Abraham in the Old Testament, we find the practice of burying a model, as distinct from the thing itself.

Thousand tombs

The South Kensington model was removed from a tomb in the XIIth dynasty necropolis at Beni-Hasan on the east bank of the Nile, 169 miles south of Cairo where about a thousand tombs lie in the valley at the foot of a cliff below the rock tombs of princes and monarchs. Mast and sail were missing but the later discovery at Thebes of ships belonging to the same period (about 2000 BC) enabled modern replicas to be fitted.

All the model boats of the XIth, and XIIth dynasties so far excavated are cut in block with the hull prolonged downwards. This curious feature—and here is a warning of what may follow when a modeller departs from realism !—has led some people into thinking that it represents the shape of the original boat. In fact, the distortion was deliberate, the model having been made so as to stand on its own base.

The same characteristic occurs in some modern models from the Ganges. There are also certain resemblances in actual construction between the dinghies on the Ganges today and the funerary boats of Egypt many centuries ago. One of the fascinations of the Ships Gallery at the Science Museum lies in the detection of similarities revealing the line of development through different periods and in different countries.

If you want to know how the Elizabethan seamen hoisted their yards, then look at the dhows from the Arabian Sea; if you seek the details of constructing an Elizabethan quarter gallery, study the junks which ply on the water of Northern China. The hogging truss, employed in Egypt in the Vth dynasty to prevent a long vessel from dropping at the extremities, turns up again 26 centuries later in the paddle steamer *Empire* and the stern wheel steamer *Inez Clarke*.

As far as possible, the ship exhibits are arranged in a way which makes the continuity clearly discernible. The small craft from all parts of the world are particularly important in illustrating this development. No one visiting the Museum for the first time should miss the fishing boats from Russia and Scandinavia or those oddly named scaffies, fifies, zulus and baldies from Scotland: there is much here that can be studied and compared. The junks from Ningpo and Chinchow, the Japanese trawler from Ise Bay, the raft from Formosa, the Japanese trading sampan—all these invite our attention as we pass slowly towards the age of steam-at-sea. Only a couple of steps from a fleet modern liner we halt in front of an exhibit which indirectly gains a topical interest through the work of Djalal Yusupov at last year's Model Engineer Exhibition: a mandarin's boat elaborately carved in ivory and accurately representing a type of craft familiar in China early last century.

I mention these little vessels because most visitors, quite understandably, make a bee-line for the more impressive exhibits or, if they are modellers, become so deeply immersed in their own favourites that they have no time left for all the rest !

The greatest favourite with the initiated is, I suppose, the *Prince* of 1670. HMS *Prince*, a first rate, designed by Phineas Pett and launched at Chatham, carried the flag of the Duke of York, Lord High Admiral of England (later James II), at the battle of Solebay off the Essex coast, during the third war with the Dutch. The English had French support, and it was hardly to the discredit of De Ruyter that he finally withdrew on the approach of enemy reinforcements, though not before the English ships had suffered severely. Sir John Cox, First Captain, or Captain of the Fleet, was killed on board the *Prince*.

Authentic rigging

The flags on the model, which is to 1 : 48 scale, are those depicted in the tapestries of the battle; and so is the top-armour. In 1925, 30 years after buying this contemporary dockyard built model as an unrigged hull, the Museum added authentic rigging, keeping strictly to Sir Anthony Deane's *Doctrine of Naval Architecture*, a manuscript of 1670 which belonged to Samuel Pepys and is preserved in the Pepys Library at Magdalene College, Cambridge.

Only half a dozen seventeenth century models of an English first rate are known to exist. Besides being the finest of them, the Science Museum *Prince*, unlike the others, has had her identity established beyond doubt. Dr R. C. Anderson recognised her from the dimensions and was later proved right by a drawing of Van de Velde's in Amsterdam and by the Solebay tapestries. It was

Canadian visitor

"MOST of all," said Spence Allan from Ontario, "we enjoyed our two weeks in Cornwall."

Spence and his wife were in England for the spring after a week in Paris—a city full of memories for Mrs Allan as she went to school there. They spent ten days in London, and one of Mr Allan's first objectives, as one would expect of a keen modeller, was the ME office.

You will see him in the picture, studying the ME Jubilee Clock. This model engineer from Canada is interested in clocks and in everything else that has a place in our pages. As an enthusiast for tools in particular, he is a follower of Duplex. "I have made his handsaw and several other gadgets," he said.

When Mr Allan arrives back in Hamilton he will be busy again on a Stuart engine in the intervals from his work as manager of a printing and lithography plant. He describes himself as "a bit of a lone wolf" in Hamilton. The city is not without model engineers and there is a good deal of activity among model railroaders.

Mr Allan enjoys ME. As well as following the constructional articles which please his technical bent, he likes to read about subjects of general interest, such as full-scale engines or miniature railways in various places. He added that an article on the Toronto-Hamilton railway, now converted to diesel, would give pleasure to readers in Canada.

Mr Spence Allan inspecting the Jubilee Clock when he visited the ME offices

Touring USSR lines

A DELEGATION from the British Transport Commission has just been on a three weeks' tour of the Soviet railways. Their itinerary covered progress in electrification and diesel traction; gas turbine development; permanent way construction; train operation; the design of passenger coaches and wagons; and signalling telecommunications and automatic train control.

This, of course, is all very praiseworthy and how it should be, but if you had your choice where would you go rooting in Russia? For myself I could not resist searching out—if some of them still exist—those fabulous monsters that hauled the trans-Siberian expresses.

I believe, too, that there were some queer looking steam locomotives leading a leisurely existence on the branch lines, but how far these have been displaced by diesel and electric engines is, for me at least, something of a mystery.

70-year-old model

A MODEL of the *Great Eastern* which was made 70 years ago was presented to the National Maritime Museum when Sir Alan Herbert opened its summer exhibition on May 21.

The model, which was presented by Sir John Dean on behalf of the Telegraph Construction and Maintenance Company (now universally known as Telcon), is fitted with a steam engine to drive the paddles and a clockwork motor for the screw.

It will form part of the Sail to Steam Exhibition which will show, in pictures and models, how during the last century the ship evolved from the sailing ship proper, through the sailing ship with auxiliary engines and the steamship with auxiliary sails to the steamship.

Models of some of the early engines which powered the first steam-driven vessels will be on view.

Cover picture

Some angled shots of the model of the KRONPRINSESSE INGRID *which was built by D. W. Greenslade of Torquay, Devon, who describes its construction on pages* 766 *and* 767.

Name wanted

IN the issue of March 27 we published a cover picture showing two views of a partly finished sixth rate under construction by an ME reader.

The Editor would like to get in touch with this reader but unfortunately his name and address are not known. Perhaps he (or could it be she ?) would drop us a line.

Full size models!

I HAVE always understood that modelling implied constructing a replica in miniature, but after reading a letter in *Engineering* I am beginning to wonder ! Ian Nickols, of Nickols Automatics, Oxted, Surrey, wrote :

"Your 'Plain Words' about model engineering remind me of the time when I took an enthusiastic toolmaker to the Model Engineer Exhibition. Discussing the fascination of this hobby, I suggested that the development of our own automatic capstan lathes really came into the same category. Without hesitation he said: 'That's right. Model making on a scale of twelve inches to the foot.'"

For myself, I am never certain how large a representation can be before it fails to qualify as a model.

For example, those giant insects about a thousand times larger than life that were on show at the Festival of Britain—were they "models" ?

Model Engineer

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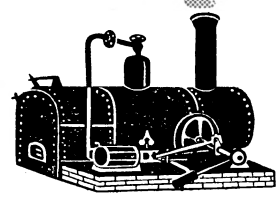
Smoke Rings

By VULCAN



JUST how wide is the influence of MODEL ENGINEER it is difficult to ascertain, but time and again I am surprised to hear of professional engineers who read its pages regularly or read it at a formative stage in their careers.

There were one or two examples of this in the congratulatory messages which were received by ME from prominent people; the latest instance to come to my notice is from Mr G. C. Moore, who is in the Department of the Civil Engineer-in-Chief at the head office of the Admiralty.

Including himself, there are six members of his department who are active model engineers and four of them read this magazine. He tells me that he finds himself in the position of giving service and advice to the others because his modelling experience happens to cover a wider scope and extends over a longer period than any one of his colleagues.

They have their own annual exhibition at which models and workshop appliances, all made by the staff, are displayed.

I am happy to quote Mr Moore's statement about MODEL ENGINEER: "I hear no adverse comments on ME; one and all seem to regard it as an interesting and well balanced magazine."

Track photographs

SOME of the finest pictures of railways and locomotives ever taken by a camera are the work of Brian A. Butt.

The best craftsmanship springs from a loving interest in the subject, and it is this affection which inspires Mr Butt whenever a photogenic engine, old or new, comes within his focus. In the days when less of his time was spent in travelling and in obeying the demands of the unexpected, he belonged to SMEE, modelled live steam locomotives, and helped to lay down a $3\frac{1}{2}$ in. gauge track in a garden on the Cornish coast near Devoran.

Every now and then he leaves his home in St Ives and wanders off with his camera to see what other countries have to offer. One day, outside a cafe in Barcelona, he spotted a locomotive of 1860—the engine shown in ME of June 13 last year when the question: "Where shall we find the world's oldest working locomotive?" led to an interesting correspondence.

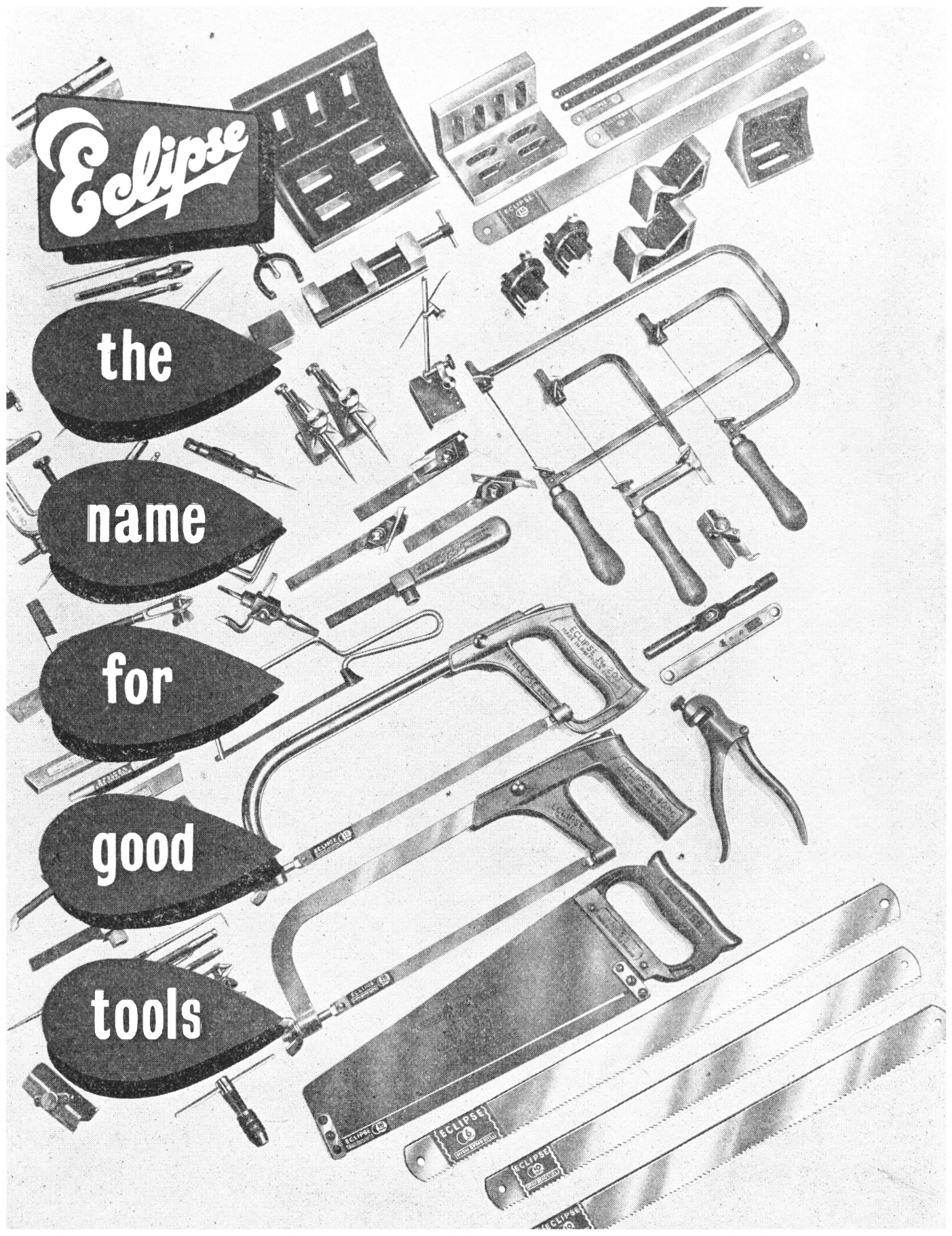
You never know when or where Mr Butt will turn up. The last time I saw him he was fresh from the excitements of Paris after a trip to the United States, his second in two years. He has photographed all sorts of American subjects from the giant turbo-electric locomotives to the desert in lovely flower.

Scenic layout

As an example of the enthusiasm for miniature railways in the USA, he mentioned a club meeting which he attended in the flourishing Texas city of Houston. The club had been lent a huge room by the local railroad, and in the centre was an O gauge electric track with beautiful mountain scenery and a highly elaborate system of control.

At Jacksonville he was struck by the use of ground signals, a station with about a dozen platforms appearing at first sight to have no signals at all! But while so much on the American railroads is thrillingly modern, America is also full of delights and surprises for the lover of little branch lines. "There are thousands of them," said Mr Butt, happily; and he gave, as an example, the line at Scotland Neck, a town full of Macs in North Carolina.

Mr Butt's only disappointment in the United States on his second visit—apart from the general slow-down of the recession—was his arrival in Santa Barbara at just the wrong time. Seymour Johnson, whose track is famous, had left on a visit to Italy.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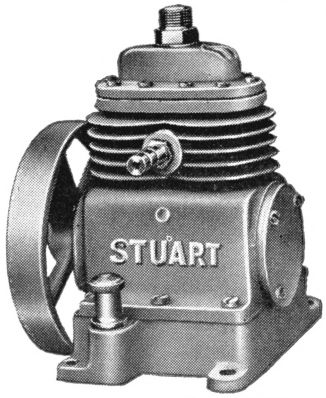

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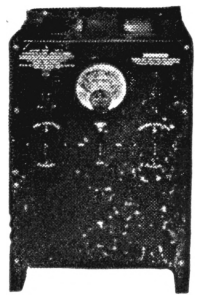

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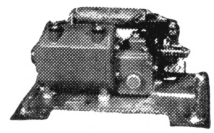

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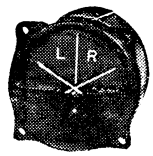

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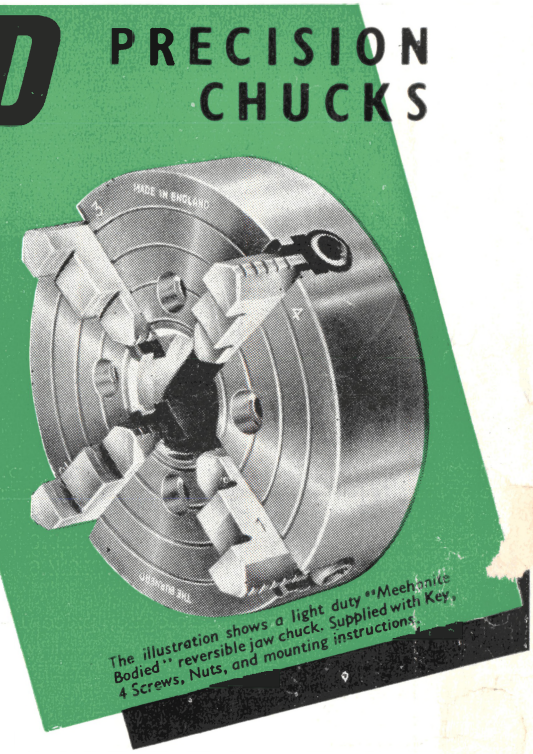

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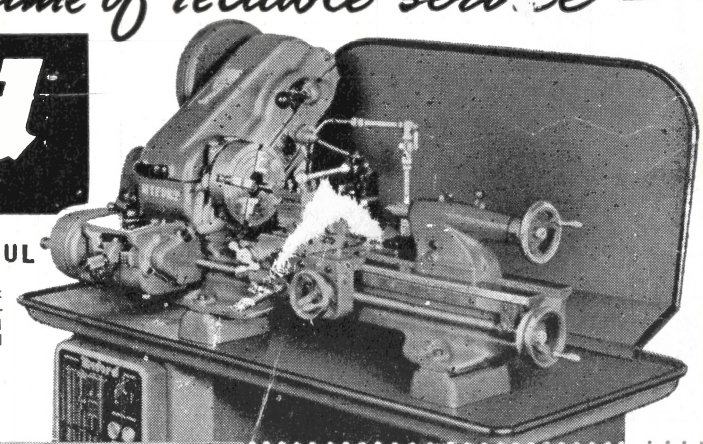

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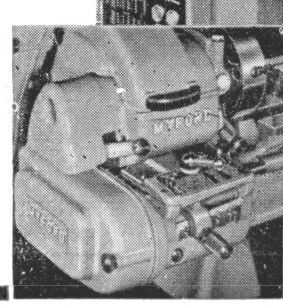

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